

**Collaborative design processes:
Developing adaptive processes for OBM
firms and design agencies across varying
levels of design maturity**

**A Thesis Submitted for the Degree of
Doctor of Philosophy**

By

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DECLARATION

I hereby declare that I am the sole author of this thesis. The work presented herein was carried out in accordance with the requirements of the University's Regulations for the Degree of Doctor of Philosophy and is entirely the result of my own investigation and evaluation, except where otherwise indicated by specific reference in the text. I confirm that this work has not previously been submitted for any degree, nor is it currently being submitted or considered for any other academic award.

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ABSTRACT

This study investigates how collaborative design processes can be developed to enhance cooperation between OBM (Original Brand Manufacturing) firms and design agencies operating at different levels of design maturity. The central aim is to develop collaborative design processes (CDPs) that foster mutual understanding, strengthens inter-organisational integration, and supports design-led innovation and competitiveness.

Focusing on South Korean OBM firms transitioning from OEM (Original Equipment Manufacturing) and ODM (Original Design Manufacturing) models, the research examines how design collaboration operates in practice within industrial contexts characterised by engineering-dominant structures and hierarchical cultures. Through ten qualitative case studies in consumer electronics, robotics, and industrial appliances, the study examines how OBM firms and design agencies interact, negotiate, and co-develop design solutions across differing organisational and cultural settings.

A qualitative multi-case study methodology was adopted, incorporating semi-structured interviews, participatory observation, and comparative analysis of collaboration structures. The theoretical framework integrates the Danish Design Ladder (DDL) with an empirically grounded Collaborative Design Process (CDP) model, revealing how varying levels of design maturity shape collaboration dynamics, decision-making, and innovation outcomes.

Findings indicate that most OBM firms remain at early design maturity stages (1–2), where collaboration is transactional and output-oriented. A few firms display Stage 3 characteristics (Design as Process), showing emergent integrative practices, while Stage 4 (Design as Strategy) remains largely unattained. Persistent barriers include engineering-dominant hierarchies, fragmented communication, and insufficient design leadership.

The study contributes by proposing collaborative design processes that align design agencies' methodologies with the evolving maturity of OBM firms. Theoretically, it positions design as a collaborative and dynamic organisational capability. Practically, it provides actionable insights for managers and designers to embed structured collaboration, bridge internal–external expertise and advance towards design-led innovation systems.

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Glossary

CMF (Colour, Material, Finish)	Visual detailing standard in design for maintaining coherence in colour, material, and finish treatment.
Collaborative Design Process (CDP)	Framework describing integrated collaboration between design and engineering across OBM maturity stages.
Compliance and experience-aware QA	Quality assurance method combining regulatory and experiential criteria to enhance holistic validation.
Concept exploration	Early creative phase in the CDP for defining user needs and prototyping low-fidelity concepts.
Danish Design Ladder (DDL)	Model illustrating four maturity stages of design integration in organisations, from non-design to design as strategy.
Design Automation (DA)	Process of automating repetitive design tasks through digital tools, enhancing consistency and efficiency.
Design Optimisation (DO)	Computational process of improving design outcomes through efficiency and performance metrics.
Design Thinking (DT)	Iterative human-centred design methodology incorporating empathy, ideation, prototyping, and testing.
Manufacturability review	Phase assessing whether design specifications can be effectively realised within production constraints.
Post-project learning / post-launch learning	Reflective process after project completion for capturing insights and improving future design efficiency.
Process manager	Role within PMO responsible for maintaining documentation, knowledge continuity, and cross-project alignment.

Product Lifecycle Management (PLM)	Integrated system connecting product design and manufacturing through digital data flow.
Product–Process Matrix (PPM)	Hayes & Wheelwright’s (1979) framework linking product variety to process type for operational alignment.
Quality Assurance (QA)	Continuous validation framework aligning engineering verification with user experience evaluation.
Refine–Check loop	Feedback cycle between design and engineering ensuring early error detection and improvement.
Role & Responsibility (R&R)	Framework assigning clear ownership and accountability among departments to streamline decision-making.
Total Design (TD)	Pugh’s integrated design framework covering all phases from identifying market needs to final delivery.
User-Centred Design (UCD)	Norman’s user-oriented approach focusing on cognitive psychology principles for design usability.

Abbreviation

AI	Artificial Intelligence
B2B	Business-to-Business
CAD	Computer-Aided Design
CDP	Collaborative Design Process
CMF	Colour, Material, Finish
DA	Design Automation
DDL	Danish Design Ladder
DO	Design Optimisation
DT	Design Thinking
DVT	Design Validation Test
EVT	Engineering Validation Test
KPI	Key Performance Indicator
NIE	Newly Industrialised Economy
NPD	New Product Development
OBM	Original Brand Manufacturing
ODM	Original Design Manufacturing
OEM	Original Equipment Manufacturing
PLM	Product Lifecycle Management
PMO	Project Management Office
PPM	Product–Process Matrix
PPVA	Post-Production Value Added
PVT	Production Validation Test

QA	Quality Assurance
R&D	Research and Development
R&R	Roles and Responsibilities
TNC	Transnational Corporation
UCD	User-Centred Design
UX	User Experience
TD	Total Design

Chapter 1. Introduction

1.1 Introduction

The design process has long been a subject of academic and professional inquiry, yet its significance has deepened in today's context of global competition, digital transformation, and increasingly complex industrial networks. Unlike manufacturing processes that can be standardised and optimised, the design process remains inherently iterative, interpretive, and creative (Cross, 2006; Lawson, 2006). This fluid and often ambiguous nature make design both difficult to codify and indispensable to manage, particularly for firms transitioning from Original Equipment Manufacturing (OEM) and Original Design Manufacturing (ODM) to Original Brand Manufacturing (OBM).

In such contexts, design is no longer a peripheral styling activity but a strategic and integrative capability that connects innovation, brand identity, and organisational learning (Bruce & Bessant, 2002; Best, 2010). This evolution aligns with the Danish Design Ladder (Design Council, 2006), which conceptualises the organisational maturity of design across four stages, from No Design to Design as Styling, to Design as Process, and ultimately Design as Strategy. Many manufacturing firms, especially those in East Asia, remain positioned at the early stages, where design is perceived primarily as aesthetic enhancement rather than a strategic driver of value creation. Understanding how to move design practice upward along this ladder has therefore become a central challenge for both scholars and practitioners.

Design has been broadly defined as the purposeful transformation of ideas into tangible products, services, or systems that create value and address human needs (Buchanan, 1992; Nelson & Stolterman, 2012). Yet the question of how design unfolds as an organisational process remains contested. Early rationalist and engineering-based models conceptualised design as a linear, stage-based sequence of analysis, synthesis, evaluation, and implementation (Simon, 1969; Pahl & Beitz, 1996). These frameworks provided structure but failed to capture the social, collaborative, and dynamic dimensions of real-world design practice. Later scholars emphasised design as a reflective and situated activity, shaped by context, interpretation, and iteration (Schön, 1983; Dorst, 2006).

Over time, design research has expanded from individual cognition to collective collaboration. Participatory and user-centred design approaches positioned stakeholders as active contributors, bridging professional expertise and end-user insight (Sanders & Stappers, 2008; von Hippel, 2005). The emergence of design thinking reframed design as a transdisciplinary problem-solving methodology applicable to management, policy, and social innovation (Brown, 2009; Martin, 2009). More recently, strategic design perspectives have explored how design can be embedded into organisational systems to shape decision-making, innovation, and long-term competitiveness (Borja de Mozota, 2003; Verganti, 2009).

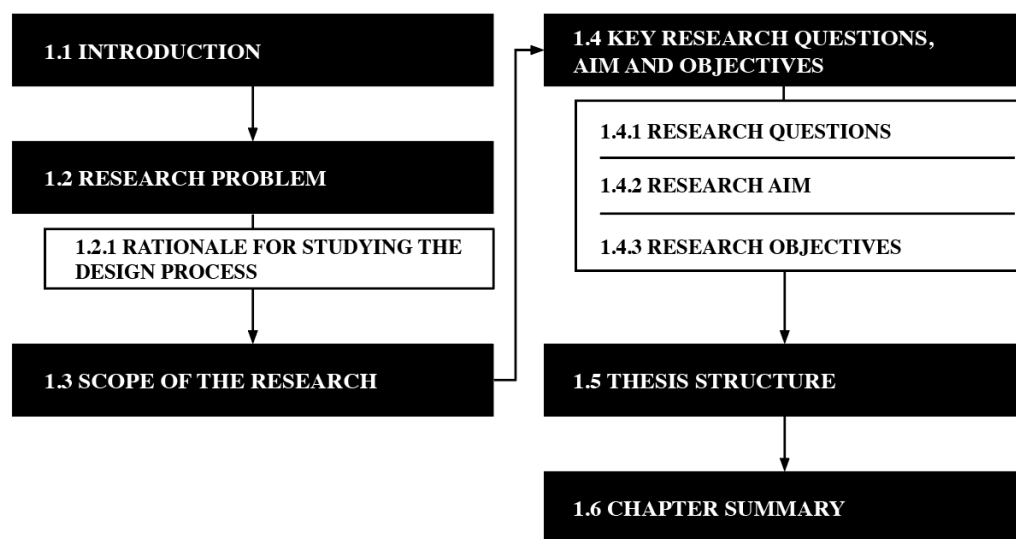
Despite these advances, a gap remains in understanding how design processes can be collaboratively structured and institutionalised within organisations, particularly among East Asian OBM firms. Following the global industrial shift since the late twentieth century, East Asia became a key manufacturing hub where multinational corporations outsourced production to achieve efficiency and scale (Hobday, 1995; Gereffi, 1999). Countries such as South Korea, Taiwan, and China developed strong engineering-based OEM and ODM systems but maintained relatively weak design capabilities, constrained by hierarchical decision-making and compressed industrial growth (Lin & Chen, 2007). Within this regional context, South Korea has been selected as the focal case of this study, as its manufacturing firms exemplify the ongoing transition from efficiency-driven OEM and ODM models toward OBM strategies led by design differentiation. However, this transformation has revealed structural tensions between design and engineering, creativity and control, and internal teams and external design partners, leading to fragmented collaboration and limited design maturity.

This research addresses these gaps by investigating how collaborative and adaptive design processes can be developed and implemented between OBM firms and design agencies. It aims to establish a process that enhances mutual understanding, strengthens cross-organisational collaboration, and supports design-led competitiveness. The study positions this as a step towards advancing firms along the Danish Design Ladder, moving from styling-oriented practice to process-oriented and, ultimately, strategy-oriented design integration.

By bridging theoretical perspectives with empirical evidence from South Korean and East Asian manufacturing contexts, this study contributes to the discourse on design as a dynamic organisational capability, one that thrives through collaboration rather than isolation.

Ultimately, it redefines design not merely as a tool for product creation but as a strategic, cultural, and relational process that integrates creativity with structure and innovation with cooperation. Through this lens, the research clarifies how OBM firms can evolve beyond transactional outsourcing toward sustained, adaptive partnerships that institutionalise design as a collaborative organisational strength.

Figure 1.1 Overview of the overall structure and procedural flow of this chapter.



[Figure 1. 1: Chapter map]

1.2 Research problem

The necessity and rationale for this research originate from the industrial upgrading of East Asian manufacturing and from the strategic yet underexamined role that design plays in this process. Since the late twentieth century, East Asian economies such as South Korea and Taiwan have moved beyond stages centred on OEM and ODM, pursuing value creation through OBM that is grounded in design, branding, and innovation (Hobday, 1995; Amsden & Chu, 2003). While OEM and ODM firms secured advantages in efficient production and quality control, they did not escape structural dependence on overseas partners that owned the brands (Gereffi, 1999; Sturgeon, 2002). In contrast, OBM demands a new configuration in which firms proactively integrate design, branding, and market strategy, shifting the focus of value creation from cost efficiency to differentiation and innovation. As cost-based advantages of OEM and ODM have gradually diminished, countries such as South Korea have increasingly

accelerated their transition toward OBM as a pathway to sustainable competitiveness. In this regard, South Korea provides a compelling context for investigation, as its accumulated experiences illustrate both the opportunities and constraints of moving from manufacturing efficiency to design-driven value creation (Hobday, 2010; Chung & Kim, 2015). In this process, design is not a choice, but a core driver of corporate competitiveness.

In the OBM context, design functions as a dynamic capability. That is, it serves as a means by which organisations integrate, build, and reconfigure capabilities to foster innovation in rapidly changing environments (Teece, Pisano, & Shuen, 1997; Martin, 2009). However, many East Asian firms remain at the lower stages of the Danish Design Ladder (Design Council, 2006) and tend to regard design as a simple styling activity rather than as strategy or process. If a collaborative design process (CDP) that connects internal teams with external design agencies is not established, design risks becoming isolated and aestheticised, disconnected from corporate strategy. Accordingly, this study does not view this problem as one of technical optimisation, but as a process of adaptive collaboration that embeds design within organisational structures and decision-making systems.

Meanwhile, technological change and the restructuring of industrial systems make the limitations of design processes even more apparent. Design practice is changing rapidly due to the spread of digital tools such as AI-assisted ideation, computer-aided modelling (CAD), and rapid prototyping, and in this environment adaptive collaboration between companies and design agencies is emerging as an essential capability (Norman & Verganti, 2014; Bruce & Bessant, 2002). This digital transition simultaneously increases the speed and complexity of design and deepens information asymmetries and decision-making discontinuities between organisations (Cross, 2006; Dorst, 2011). Therefore, there is a need to build a CDP that shares knowledge, culture, and decision-making structures rather than relying on simple outsourcing relationships (Erichsen & Christensen, 2013). At the same time, sustainability and responsible innovation are being internalised as core components of the design process (Papanek, 1985; Manzini, 2015; Fletcher & Tham, 2019), and local design capability is emerging as a strategic alternative for alleviating dependence on global supply chains and for building agile and autonomous design execution structures (Best, 2010; Kim & Eum, 2022).

Case studies show both the opportunities and the risks in this transition to OBM. Samsung Electronics grew into a global brand by establishing design centres, institutionalising user

research, and integrating design with corporate strategy (Jang, Lee, Kim, & Choi, 2019). Hyundai Motor Company likewise institutionalised design within its product development system by expanding an international network of design studios and introducing structured collaboration processes (Chung & Kim, 2015). In contrast, many small and medium-sized East Asian firms, relying on superficial styling without building process-driven design capability, failed to sustain their OBM strategies (Hobday, 2010). This suggests a critical point: without CDPs, the transition to OBM remains incomplete.

Finally, the significance of this problem is confirmed by an academic research gap. Although debates on design thinking and design management have been active in Western scholarship (Bruce & Bessant, 2002; Best, 2010), there is a lack of empirical research on how design processes are structured, managed, and advanced through collaboration in the context of OBM firms. In particular, there is little analysis of how internal design maturity and external collaboration interact to influence innovation performance. Therefore, this thesis seeks to fill this gap by identifying the mechanisms through which OBM firms and design agencies co-develop adaptive design processes that enhance design outcomes and strengthen strategic competitiveness.

1.2.1 Rationale for studying the design process

The transformation from OEM to ODM and ultimately to OBM does not represent a simple linear upgrade in production sophistication, but rather a paradigmatic shift in how value is created, communicated, and sustained within industrial systems. This evolution marks a transition from efficiency-based competition, characteristic of OEM firms, to differentiation- and identity-based competition, which defines mature OBM enterprises (Hobday, 1995; Gereffi, 1999). At the OEM stage, firms compete primarily through cost efficiency, manufacturing reliability, and volume production, producing under the specifications of brand-owning clients that retain control over design, marketing, and strategic direction. As production costs rise and competitive advantage from efficiency diminishes, firms in East Asia, most notably in South Korea, Taiwan, and China, face pressure to upgrade toward higher value-added functions. This progression, widely observed in late-industrialising economies, represents a structural necessity rather than a discretionary choice (Amsden & Chu, 2003; Lin & Chen, 2007; Park W-M. et al., 2007).

At the ODM stage, firms begin to internalise design and engineering capabilities, partially extending creative control over product development (Mathews, 2002; Chen, 2009). Yet even here, they remain dependent on external brand owners for market identity and strategic positioning, leading to limited visibility in consumer markets and a continued asymmetry in value capture. The shift to OBM, therefore, constitutes not just a functional upgrade, but a fundamental reorientation of organisational identity: firms must develop and manage their own brands, integrating design, innovation, and consumer experience into a unified strategic system (Kapferer, 2012; Best, 2010). In this context, design becomes not a downstream embellishment but a strategic instrument through which meaning, differentiation, and long-term competitiveness are achieved.

However, the challenge for East Asian firms lies not only in adopting design, but in learning how to collaborate effectively to produce coherent, competitive design outcomes. South Korea exemplifies this challenge vividly. Many manufacturing-oriented firms, long accustomed to hierarchical, engineering-led structures, struggle to integrate creative practices into established routines (Kim, 2017; Lee & Cho, 2020). While large enterprises such as Samsung and Hyundai have institutionalised design by building global design centres and embedding design into corporate decision-making (Jang, Lee, Kim, & Choi, 2019; Chung & Kim, 2015), smaller firms often remain constrained by limited design maturity, fragmented communication, and transactional outsourcing relationships with external design agencies (Hobday, 2010). These conditions underscore the need for collaborative and adaptive design processes, processes that enable OBM firms and design agencies to jointly manage design development, align creative intent with market strategy, and build long-term capability through shared learning.

The rationale for studying the CDP in South Korea also carries broader regional significance. The trajectory observed in South Korea mirrors a broader East Asian pattern, where countries that initially relied on low-cost contract manufacturing have faced rising labour costs and diminishing returns to efficiency, prompting an inevitable transition toward OBM and brand-based competition (Hobday, 1995; Gereffi, 1999; Hung, 2008). Thus, while this research focuses empirically on South Korean firms, the findings can be analytically transferable to other late-industrialising economies in East Asia. The pressures of compressed industrialisation, short product cycles, high export dependence, and limited design heritage create shared

conditions under which CDPs become critical for sustainable competitiveness (Amsden & Chu, 2003; Lin & Chen, 2007).

From a theoretical standpoint, this study contributes to the literature by reframing design not as an isolated function or managerial optimisation task, but as a collaborative process capability, a dynamic mechanism through which multiple actors co-create value within and across organisational boundaries (Bruce & Bessant, 2002; Erichsen & Christensen, 2013). Existing models of design thinking and design management, largely derived from Western contexts, provide valuable conceptual tools but remain insufficient to explain how collaboration unfolds in hierarchical, engineering-dominant, or resource-constrained settings (Cross, 2006; Dorst, 2011). By focusing on how Korean OBM firms and design agencies build adaptive collaboration structures, this research extends design theory toward a more situated, relational, and contextually embedded understanding of design processes.

Finally, the policy relevance of this inquiry cannot be overlooked. The South Korean government has consistently positioned design as a key driver of industrial upgrading, innovation, and national competitiveness, as seen in initiatives led by the Korea Institute of Design Promotion (KIDP) and the Ministry of Trade, Industry and Energy (Kim & Eum, 2022). Yet the effectiveness of these national strategies ultimately depends on firms' ability to internalise design collaboration as a sustained organisational practice rather than an externalised procurement activity. Studying the CDP in OBM firms thus provides a lens for assessing the alignment between macro-level policy intentions and micro-level organisational realities, revealing how national competitiveness is contingent upon the institutionalisation of collaboration-based design capability at the firm level.

In summary, the rationale for studying CDPs in OBM firms rests on four interlinked arguments. First, OBM represents a qualitative transformation in value creation, where design collaboration is indispensable for differentiation and strategic resilience. Second, the South Korean experience exemplifies both the promise and the fragility of design integration within compressed industrial development, offering lessons applicable across East Asia. Third, the study fills an academic gap by analysing design processes as collaborative and adaptive capabilities rather than managerial routines. Lastly, it provides insights of practical and policy relevance, linking firm-level collaboration mechanisms with national strategies of industrial innovation. Collectively, these perspectives demonstrate why design collaboration must be

understood as a central determinant of sustainable competitiveness for OBM firms in the twenty-first century.

1.3 Scope of the research

The scope of this research has been carefully defined to ensure both academic rigour and practical relevance. While the study of design processes is expansive, encompassing diverse industries, methodologies, and theoretical perspectives, this thesis focuses specifically on the CDPs in OBM firms within East Asian contexts, with a particular emphasis on South Korean firms. This section clarifies the boundaries of the study, identifies its intended audience, and explains why these choices are both necessary and appropriate. Figure 1.2 illustrates the research scope.

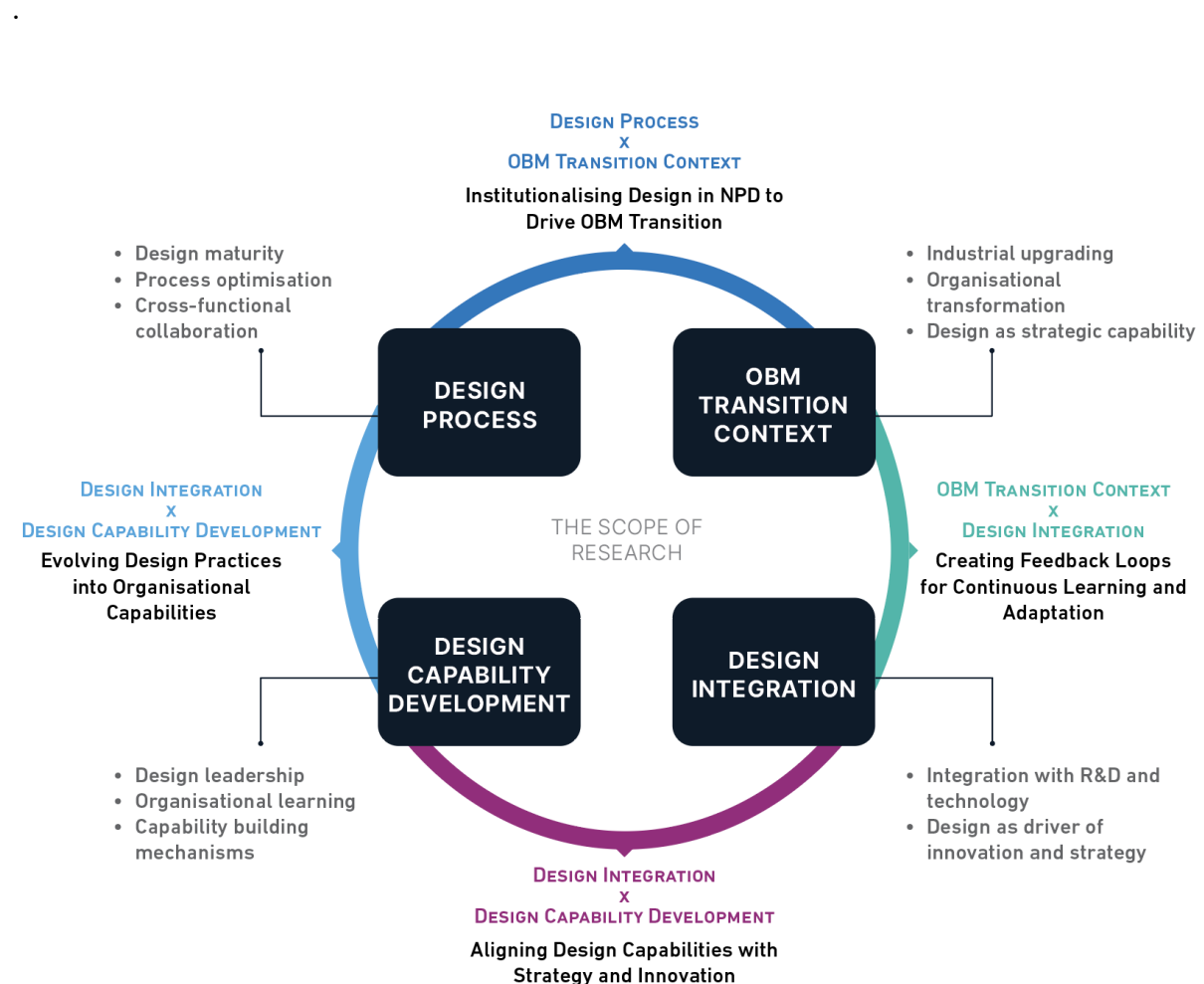


Figure 1. 2: Scope of research

1) Scope of the research

This research is situated at the intersection of design studies, innovation management, and industrial upgrading, focusing on how design processes can be collaboratively structured and managed to enhance competitiveness in OBM firms. Unlike OEM and ODM contexts, where design remains peripheral or externally driven, OBM firms assume responsibility for conceiving, producing, and marketing products under their own brands (Hobday, 1995; Mathews, 2002). Within this paradigm, design becomes a core organisational capability that integrates creativity, strategy, and inter-organisational collaboration.

Geographically, the research focuses on the East Asian region, with particular emphasis on empirical case studies of South Korean and Chinese firms, while extending comparative insights to Taiwan and Vietnam. These economies exemplify compressed industrial trajectories, having transitioned from OEM and ODM to OBM models within relatively short periods (Hobday, 1995; Amsden & Chu, 2003; Lin & Chen, 2007). This accelerated industrial evolution provides a robust empirical foundation for examining how design processes are developed, challenged, and adapted under conditions of rapid economic and organisational transformation. While Western firms are occasionally referenced for comparative perspective, the primary focus lies in understanding design as a collaborative organisational capability within the distinctive cultural, institutional, and economic contexts of East Asia.

Industrially, the research concentrates on the consumer goods, electronics, home appliance, and automotive sectors, where design plays a decisive role in shaping competitiveness and brand differentiation. These industries not only represent major contributors to national economies but also serve as critical testbeds in which design collaboration between firms and agencies is visibly enacted and assessed against global standards (Chung & Kim, 2015; Jang, Lee, Kim & Choi, 2019; Lin & Chen, 2007). This selection does not imply that design is unimportant in other industries; rather, it highlights sectors where the impact of CDPs on strategic and operational outcomes is most pronounced.

Accordingly, the scope of this research integrates organisational and inter-organisational perspectives, addressing how OBM firms and external design agencies can co-develop adaptive design processes suited to different levels of design maturity. The aim is not simply to describe existing practices but to identify pathways through which collaboration can strengthen design

capability and foster sustained, design-led competitiveness within East Asia's rapidly evolving industrial landscape.

2) Conceptual boundaries

Conceptually, the research is concerned with the *process* of design rather than with design outcomes per se. While product aesthetics and innovation results are important, the central focus is on the organisational mechanisms, routines, and practices that shape how design is enacted (Borja de Mozota, 2003; Brown, 2009). This process orientation allows the study to explore how creativity is structured, integrated, and institutionalised within firms.

The research does not attempt to produce a universal model of the design process. Instead, it aims to identify principles of collaboration relevant to OBM contexts, recognising that processes are always situated and contingent (Dorst, 2006; Verganti, 2009). By concentrating on collaboration rather than prescription, the study acknowledges diversity while offering actionable insights.

3) Delimitations

Several delimitations are necessary to maintain focus. First, the study does not encompass all forms of design; it is primarily concerned with industrial and product design within OBM firms. While related fields such as service design, architectural design, or fashion design may share similar challenges, they fall outside the scope of this inquiry.

Second, the research does not attempt to evaluate national design policies in detail, although such policies provide important context. Instead, its focus remains on firm-level processes, with policy implications considered in later chapters.

Third, the study is not intended as a comparative evaluation of Western versus Eastern firms. While some comparative references are made, the core emphasis is on the distinctive conditions facing East Asian OBM firms.

4) Intended audience

The findings of this research are intended for multiple audiences.

1. **Academic scholars:** For researchers in design studies, management, and industrial policy, the thesis contributes theoretical insights into how design processes function as organisational capabilities. It positions design not only as a creative discipline but also as a structured practice, thereby adding nuance to debates in design management and innovation studies. It also invites dialogue with scholars in development studies and East Asian business, where OBM strategies are often examined primarily through economic or managerial lenses (Best, 2010; Lin & Chen, 2007).
2. **Industry practitioners:** For managers, designers, and consultants, the thesis provides practical recommendations on how to structure and optimise design processes in contexts where resources are constrained, and organisational cultures may not be naturally design oriented. By offering frameworks that balance creativity with systematic alignment, the research speaks to both large firms with global aspirations and SMEs navigating early OBM transitions. This distinction is particularly relevant because small firms often face the greatest difficulties in institutionalising processes yet also stand to benefit most from CDP.
3. **Policymakers and institutions:** For government agencies, design councils, and trade organisations, the study offers evidence on the importance of design processes in sustaining national competitiveness. It highlights how design policy can go beyond symbolic promotion and instead support capacity building, infrastructure provision, and education programmes that enable firms to embed design structurally. The research also emphasises the role of cross-national collaboration, as many East Asian firms depend on partnerships with international brands and agencies to accelerate learning.

5) Appropriateness of the Scope

The chosen scope is appropriate for both scholarly and practical reasons. By focusing on South Korean OBM firms, the study addresses a context where the stakes of design collaboration are especially high. By limiting its industrial focus, it ensures depth of analysis rather than superficial breadth. And by clarifying conceptual boundaries, it avoids conflating design process research with broader discussions of design aesthetics or creativity.

This delineation ensures that the research remains manageable while still addressing issues of significant theoretical and practical importance. In so doing, it positions the thesis to make contributions not only to academic debates but also to the strategic development of firms and the formulation of policy in design-led industrial transformation.

1.4 Key research questions, aim and objectives

The formulation of research aims, questions, and objectives is central to defining the coherence and rigour of a doctoral thesis. In the present study, these elements provide the framework through which the CDPs in OBM firms is investigated. This section articulates the overarching aim of the research, delineates the specific questions it seeks to answer, and identifies the objectives that guide its methodological and analytical strategies.

1.4.1 Research questions

The research is guided by a set of interrelated questions that break down the aim into tractable areas of inquiry. These questions are framed to address theoretical, empirical, and practical dimensions:

(RQ 1) How have design processes been conceptualised in the academic literature, and what limitations exist in applying current models to OBM firms?

This question establishes the theoretical foundation of the study by identifying key models, critiques, and gaps relevant to OBM contexts (Cross, 2006; Dorst, 2011).

(RQ 2) What organisational and contextual factors shape the design processes of East Asian OBM firms, with particular reference to South Korea?

Situates design practice within the distinctive legacies and constraints of firms transitioning from OEM/ODM to OBM, highlighting cultural, structural, and strategic influences (Hobday, 1995; Lin & Chen, 2007).

(RQ 3) How do OBM firms currently implement and manage design processes, and what barriers or challenges inhibit collaboration?

Directs the empirical investigation towards current collaborative practices, examining how OBM firms and design agencies coordinate their design activities and identifying the strengths, weaknesses, and recurring barriers that hinder effective collaboration.

(RQ 4) How can CDPs be developed for use by OBM firms and design agencies to balance creativity with consistency and ensure both innovation and strategic alignment?

Focuses on the central concern of the thesis, the CDP, by exploring how OBM firms can institutionalise design as a strategic capability while retaining flexibility (Verganti, 2009; Brown, 2009).

These questions ensure that the research addresses both micro-level organisational processes and macro-level policy implications, creating a holistic framework of inquiry.

1.4.2 Research aim

The primary aim of this research is to develop CDPs that enables OBM firms and design agencies to work more effectively together across varying levels of design maturity. This study seeks to establish a shared design process that facilitates mutual understanding, enhances collaboration, and ultimately improves design outcomes and organisational competitiveness. The process helps bridge the gap between academic theory and professional practice by proposing a process framework that reflects the complex realities of collaboration between internal corporate teams and external design partners.

Although the importance of design has been widely recognised in scholarly literature, limited attention has been paid to how collaborative design practices can be systematically structured and embedded within organisational routines, particularly in the context of East Asian OBM firms (Bruce & Bessant, 2002; Best, 2010). This study therefore moves beyond a descriptive understanding of design management to propose a conceptual and practical framework for adaptive collaboration. By addressing the misalignment that often exists between OBM firms' internal design maturity and the methodologies employed by professional design consultancies, the proposed framework seeks to support more coherent and strategically integrated design processes.

The empirical focus of this research is on the South Korean manufacturing sector, where the transition from OEM to OBM continues to reshape industrial dynamics. While earlier stages of industrial upgrading were characterised by efficiency-based OEM operations (Hobday,

1995), the current phase requires the development of design-led, brand-oriented capabilities. Yet, many firms remain constrained by uneven levels of design management, fragmented collaboration mechanisms, and limited experience in managing cross-organisational design processes. Accordingly, this research proposes a structured yet adaptive collaborative process that allows OBM firms and design agencies to co-develop products, strategies, and experiences aligned with each firm's design maturity level.

While grounded in the South Korean industrial and cultural context, this research is designed to have broader applicability across East Asian economies undergoing similar transformations from OEM to OBM. Firms in Taiwan and China, for instance, have followed comparable developmental trajectories, evolving from production-based subcontracting towards independent brand ownership (Hobday, 1995; Hung, 2008; Lee, Choe, & Kim, 2013). This regional commonality underscores the wider relevance of the proposed CDP as a strategic mechanism for aligning diverse stakeholders and fostering sustainable, design-driven competitiveness.

Furthermore, this research positions design not merely as an aesthetic or functional element but as a strategic organisational capability. It explores how design processes can institutionalise creativity, support strategic alignment, and deliver sustained long-term value. Through this lens, the study makes a dual contribution. First, it advances theoretical understanding of design as a process capability, deepening academic discourse on the integration of design within organisational and industrial systems. Second, it offers practical guidance for firms and policymakers seeking to embed design strategically in processes of organisational and industrial transformation.

1.4.3 Research objectives

The objectives of the research translate the aim and questions into specific tasks. They serve as practical signposts for the research process, ensuring that the study remains focused, systematic, and feasible.

(OB 1) To review and critically evaluate existing literature on design process models and OBM strategies.

This objective provides the conceptual foundation, identifying theoretical strengths and gaps that inform the research design.

(OB 2) To analyse the historical and contemporary trajectories of East Asian firms transitioning from OEM/ODM to OBM, with emphasis on the role of design.

This objective situates the research within broader developmental and industrial contexts.

(OB 3) To investigate empirically the current design processes of OBM firms through case studies, interviews, and participatory observation, capturing both practices and challenges.

This objective ensures that the research is grounded in real-world organisational experiences.

(OB 4) To identify barriers and enablers of collaborative design processes in East Asian OBM firms.

This includes examining organisational structures, cultural attitudes, and resource allocations, thereby developing a nuanced understanding of the conditions that facilitate or hinder collaboration between OBM firms and design agencies.

(OB 5) To develop collaborative design processes tailored to the collaborative needs of OBM firms and design agencies.

By synthesising theoretical insights and empirical findings, this objective ensures that the study produces an actionable and context-sensitive contribution for both academia and industry.

(OB 6) To assess the proposed design processes through engagement with practitioners and experts.

This objective ensures that the process is not only theoretically robust but also practically relevant and validated by those directly involved in design-led industrial transformation.

Alignment of aim, questions, and objectives

The coherence and rigour of this doctoral research rest upon the logical integration of its overarching aim, research questions, and specific objectives. The central aim of this study is to

develop CDPs that enables OBM firms and design agencies to work more effectively together across different levels of design maturity. Rather than focusing solely on operational efficiency or procedural coordination, the research seeks to build a shared and structured framework for design collaboration that enhances creativity, strengthens design outcomes, and supports long-term organisational competitiveness.

The research questions break down this aim into theoretically, empirically, and practically manageable areas of inquiry.

Research Question 1 (RQ1) examines how design processes have been conceptualised in the academic literature and identifies the limitations of applying existing models to OBM contexts. Research Question 2 (RQ2) explores the organisational and contextual factors that shape the design practices of East Asian OBM firms, with particular reference to South Korea, and investigates the cultural, structural, and strategic influences that emerge in the transition from OEM/ODM to OBM. Research Question 3 (RQ3) investigates how OBM firms and design agencies currently implement and manage CDPs, identifying the key barriers and challenges that hinder effective cooperation. Research Question 4 (RQ4) explores how CDPs can be structured to balance creativity with consistency, achieving both innovation and strategic alignment. Together, these four questions encompass both micro -level organisational processes and macro-level industrial and policy implications, ensuring that the study adopts a comprehensive and multi-layered analytical approach.

The research objectives translate these questions into specific research tasks, providing a systematic and sequential direction for the study.

Research Question 1 (RQ1) corresponds directly to Objective 1 (OB1), which critically reviews and evaluates existing design process models and OBM strategies, thereby establishing the conceptual foundation of the study presented in Chapter 2. Research Question 2 (RQ2) corresponds to Objective 2 (OB2), which analyses the industrial and historical trajectories of East Asian firms transitioning from OEM/ODM to OBM, identifies the evolving role of design, and situates these developments within broader industrial and organisational contexts. Research Question 3 (RQ3) aligns with Objective 3 (OB3), which empirically investigates the current design processes of OBM firms through case studies, interviews, and participatory observation to capture both practices and challenges in collaborative work. Research Question

4 (RQ4) corresponds to Objectives 4 and 5 (OB4 and OB5), which identify the barriers and enablers of CDPs and based on these findings, develop a process model tailored to the collaborative needs of OBM firms and design agencies. Finally, Objective 6 (OB6) evaluates the proposed process through engagement with practitioners and experts, ensuring that the developed model is not only theoretically robust but also practically applicable.

By structuring the inquiry in this progressive and integrated manner, the thesis secures both methodological rigour and analytical coherence. Each research question is systematically linked to one or more objectives, and all objectives collectively converge toward the overarching aim. This cumulative structure allows the literature review, empirical findings, and conceptual development to complement and reinforce one another throughout the research process. This alignment enables the study to move logically from the diagnosis of collaborative challenges to the proposal and validation of a structured yet adaptive design process, thereby bridging the gap between theory and practice and contributing to the advancement of design as a strategic organisational capability.

1.5 Structure of the thesis

This thesis is organised to progress from conceptual foundations to empirical investigation, then to integrated discussion and applied recommendations, and finally to conclusions. The revised table of contents structures each chapter so that the research aim, questions, and objectives are addressed systematically, while reflecting conventions in design and management research and the specific requirements of studying OBM firms. Figure 1.3 presents an overview of the paper's chapter-by-chapter structure, which the following paragraphs detail.

Chapter	Title	Key contents	Thematic category
CHAPTER 1	INTRODUCTION	• Research background • Research problem • Rationale • Scope of the research • Key research questions, aim and objectives • Structure of the thesis	Research Context
CHAPTER 2	LITERATURE REVIEW	• Theoretical foundations of design process • Academic models • Limitation of traditional models • Practice-based perspectives on the design processes • The transform from OEM to OBM • The strategic role of design in OBM firms • Design challenges in the transition to OBM • External design agencies: strategic role and integration • New product development in OBM Firms • Research gap	
CHAPTER 3	RESEARCH METHODOLOGY	• Research strategy • Research design • Qualitative data analysis • Reliability and validity	Methodology
CHAPTER 4	DESIGN PROCESS IN INTERNATIONAL BRANDS AND DESIGN AGENCIES	• Selection criteria for the case study companies • Case study results from the international brands • Case study results from the design agency • Comparison	Exploration and Investigation
CHAPTER 5	DESIGN PROCESS IN OBM FIRMS	• Selection criteria for the case study OBM firms • Case study results from the OBM firms • Comparison of OBM firms	
CHAPTER 6	DISCUSSION AND RECOMMENDATIONS	• Synthesis of literature review and empirical results • Key issues across international brands, design agencies, and OBM firms • Differences from existing literature and identification of research gaps • Application of the Danish Design Ladder (DDL) framework • Integrated design maturity framework and process development for OBM transformation • The optimised design process (ODP) for OBM firms • Assessment of the ODP • The final optimised design process	Development and Assessment
CHAPTER 7	CONCLUSION	• Summary of research • Contributions of the research • Limitations of the research	Research Conclusion

Figure 1. 3: Thesis structure

Chapter 1: Introduction establishes the intellectual and empirical foundations of the study. It situates the design process as an ambiguous, iterative, and creative activity distinct from codified manufacturing, framing why it requires systematic analysis in contexts of industrial upgrading. The research problem is defined in relation to the transition from OEM/ODM to

OBM, where design shifts from a peripheral function to a strategic capability. The chapter also sets out the rationale for focusing on East Asian OBM firms, specifies the scope and intended audience, and presents the research questions, aim, and objectives. Research limitations are acknowledged, and the chapter concludes by previewing the logical progression of the thesis.

Chapter 2: Literature Review critically examines theoretical and practice-based perspectives on the design process. It begins with rationalist and engineering-based models and their limitations, then considers reflective and interpretive accounts that highlight design as emergent and socially embedded. Practice-based perspectives such as participatory design, user-centred design, design thinking, and strategic design are reviewed to show how design extends beyond artefacts to organisational transformation. The chapter then situates these debates within East Asia's OEM–ODM–OBM trajectory, highlighting structural and cultural constraints that hinder institutionalisation of design in transitional economies. It identifies both opportunities and barriers, including the role of external agencies and integration with new product development (NPD), before concluding with a conceptual framework that informs the empirical investigation.

Chapter 3: Research Methodology establishes the philosophical foundation and methodological framework of the study. Adopting an interpretivist and constructivist orientation, it conceptualises design as a socially constructed and context-dependent organisational practice shaped by culture, management, and industrial structures. The chapter employs a qualitative multi-method approach, combining case studies, semi-structured interviews, participatory observation, and document analysis to examine how design processes are adapted and collaborated within OBM firms. It defines the three research stages; Foundation, Development, and Refinement, and explains the procedures for data collection, thematic analysis, and cross-case comparison. Research rigour is ensured through triangulation, reflexive memoing, peer review, and adherence to ethical principles such as informed consent, anonymity, and secure data handling. This framework builds the methodological bridge between theoretical insight and empirical investigation.

Chapter 4: Design process in international brands and design agencies presents findings from case studies of mature design contexts. International brands are examined as benchmarks, demonstrating the institutionalisation of design through global networks, long-term investment, and integration with corporate strategy. Their practices reveal that creativity and systematic

processes can coexist, albeit through different organisational models. Design agencies are then explored as both service providers and strategic partners, capable of transferring knowledge, building client capacity, and extending innovation horizons. However, tensions emerge when OBM clients lack absorptive capacity, leading to superficial adoption of practices. By synthesising these findings, the chapter provides comparative lessons for OBM firms, highlighting both standards of maturity and pitfalls of external dependency.

Chapter 5: Design process in OBM firms reports empirical findings from firms at varying stages of maturity. The analysis reveals uneven institutionalisation: some firms integrate design into strategy with iterative, user-centred methods, while others reduce it to styling or incremental modification under cost-driven and hierarchical constraints. Interviews and observations highlight challenges including OEM/ODM legacies, limited resources, and undervaluation of design, alongside positive developments such as participatory approaches and cross-functional collaboration in younger firms. Comparative analysis shows that advanced OBMs build routines and structures to sustain design, whereas less mature firms rely on ad hoc or external initiatives. This evidence establishes the empirical foundation for understanding both the promise and constraints of OBM firms' design processes.

Chapter 6: This chapter synthesises the theoretical and empirical findings of the study to analyse how design evolves into a strategic organisational capability within OBM firms. The study positions design not as a procedural enhancement but as an organisational transformation that integrates creativity, technology, and strategy.

The findings reveal that design maturity is determined by the alignment of three interdependent factors: institutionalised processes, cross-functional collaboration, and leadership commitment. When these elements are harmonised, design transcends its aesthetic function to become a core driver of innovation. While global brands demonstrate advanced integration systems grounded in leadership and collaboration, many East Asian OBM firms remain engineering-dominant, with fragmented collaboration and limited engagement in design. This indicates that design maturity depends not only on structural refinement but also on cultural transformation and the alignment of interpretive practices across the organisation.

The chapter redefines design as a cognitive and cultural system that facilitates organisational learning and innovation alignment. Classical process models, such as those of Archer, Pahl &

Beitz, Ulrich & Eppinger, and the Design Council, provide procedural clarity but fail to reflect the iterative and socially embedded characteristics of design in industrial contexts. Accordingly, the study reconceptualises design as a dynamic organisational learning system that bridges strategic intent and operational execution.

Building on the Danish Design Ladder, the study proposes a CDP tailored to the maturity levels of OBM firms:

- Stage 1: Introduce design as a structured and visual problem-solving tool.
- Stage 2: Establish cross-functional collaboration and formal design checkpoints.
- Stages 3–4: Embed design into organisational strategy, leadership, and culture.

Expert and practitioner evaluations confirmed that the proposed CDP demonstrates high levels of clarity, feasibility, and adaptability. Ultimately, advancing design capability in OBM firms requires both structural refinement and cultural transformation. Design must become the organising principle that connects creativity, technology, and strategy, driving sustainable innovation and long-term competitiveness.

Chapter 7: Conclusions consolidates the thesis by summarising its contributions, limitations, and implications. It demonstrates that design is central to the OEM–ODM–OBM transition and must be institutionalised as a strategic capability. Theoretical contributions include extending design processes to transitional economies, while practical contributions include an improved process aligned to OBM maturity stages. Policy implications stress the need for supportive structures that match firms' absorptive capacity. Limitations such as regional scope, case-based methodology, and temporal specificity are acknowledged, while future research directions include longitudinal studies, cross-industry comparisons, and the role of digital technologies. The thesis thus advances both academic understanding and practical knowledge of design as a dynamic capability in OBM contexts.

Figure 1.4 presents the alignment of the research questions and objectives with the corresponding chapters of the thesis.

Research Questions	Objectives	Chapter/s
(RQ1) How have design processes been conceptualised in the academic literature, and what limitations exist in applying current models to OBM firms?	(OB1) To review and critically evaluate existing literature on design process models and OBM strategies.	Chapter 2
(RQ2) What organisational and contextual factors shape the design processes of East Asian OBM firms, with particular reference to South Korea?	(OB2) To analyse the historical and contemporary trajectories of East Asian firms transitioning from OEM/ODM to OBM, with emphasis on the role of design.	Chapter 2, 4 & 5
(RQ3) How do OBM firms currently implement and manage design processes, and what barriers or challenges inhibit collaboration?	(OB3) To investigate empirically the current design processes of OBM firms through case studies, interviews, and participatory observation, capturing both practices and challenges.	Chapters 4 & 5
(RQ4) How can collaborative design processes be developed for use by OBM firms and design agencies to balance creativity with consistency and ensure both innovation and strategic alignment?	(OB4) To identify barriers and enablers of collaborative design processes in East Asian OBM firms. (OB5) To develop collaborative design processes tailored to the collaborative needs of OBM firms and design agencies.	Chapters 6
(All RQs 1 - 4) Integrated synthesis	(OB6) To assess the proposed design processes through engagement with practitioners and experts.	Chapters 7

Figure 1. 4: Research questions and objectives and associated chapters

1.6 Chapter summary

This chapter outlined the conceptual foundation and framework of the research. It positioned design as a dynamic and strategic capability distinct from standardised manufacturing, essential for firms evolving from OEM and ODM to OBM models.

Section 1.1 traced the evolution of design theory from linear engineering models (Simon, 1969; Pahl & Beitz, 1996) to reflective and collaborative approaches (Schön, 1983; Brown, 2009; Verganti, 2009), highlighting the limited relevance of Western models to East Asian, hierarchy-based industries (Hobday, 1995; Lin & Chen, 2007). Section 1.2 defined the research problem within East Asia's industrial upgrading, where design functions as a dynamic capability for

innovation and competitiveness (Teece et al., 1997; Gereffi, 1999). It emphasised the lack of collaborative structures linking internal design teams and external agencies, a gap amplified by digitalisation and sustainability imperatives (Norman & Verganti, 2014; Fletcher & Tham, 2019). Section 1.2.1 presented the rationale for studying CDPs in OBM firms, noting that the OEM–ODM–OBM transition requires organisational and cultural transformation (Hobday, 1995; Kapferer, 2012). Korean examples such as Samsung and Hyundai illustrate mature integration (Chung & Kim, 2015), while most SMEs remain design-immature and dependent on external expertise (Hobday, 2010).

Section 1.3 defined the study’s scope, South Korean OBM firms in sectors such as consumer electronics and automotive focusing on CDP rather than aesthetic outcomes. Section 1.4 established the research aim: to develop a CDP for OBM firms. Four research questions and six objectives structure the inquiry, linking theory, empirical investigation, and framework development. Section 1.5 described the thesis structure, progressing from theoretical foundations to empirical analysis and synthesis.

Chapter 1 situates design as a strategic, collaborative, and adaptive capability central to industrial transformation. It defines how OBM firms can institutionalise design processes to strengthen innovation and achieve sustainable competitiveness in a design-driven global economy.

Chapter 2. Literature review

2.1 Introduction

This chapter reviews key theoretical and empirical studies on design process theory and its relevance to the transformation of manufacturing firms toward OBM. The purpose is to establish the theoretical foundation for understanding how design operates as both a process and a strategic capability, and to identify the limitations of existing processes that constrain its application in OBM contexts.

The chapter begins by examining the evolution of design process theories, from rational and engineering-based processes to reflective and human-centred paradigms and highlights their conceptual strengths and practical limitations. It then contrasts these academic perspectives with practice-based views to reveal the gap between theoretical ideals and industrial realities.

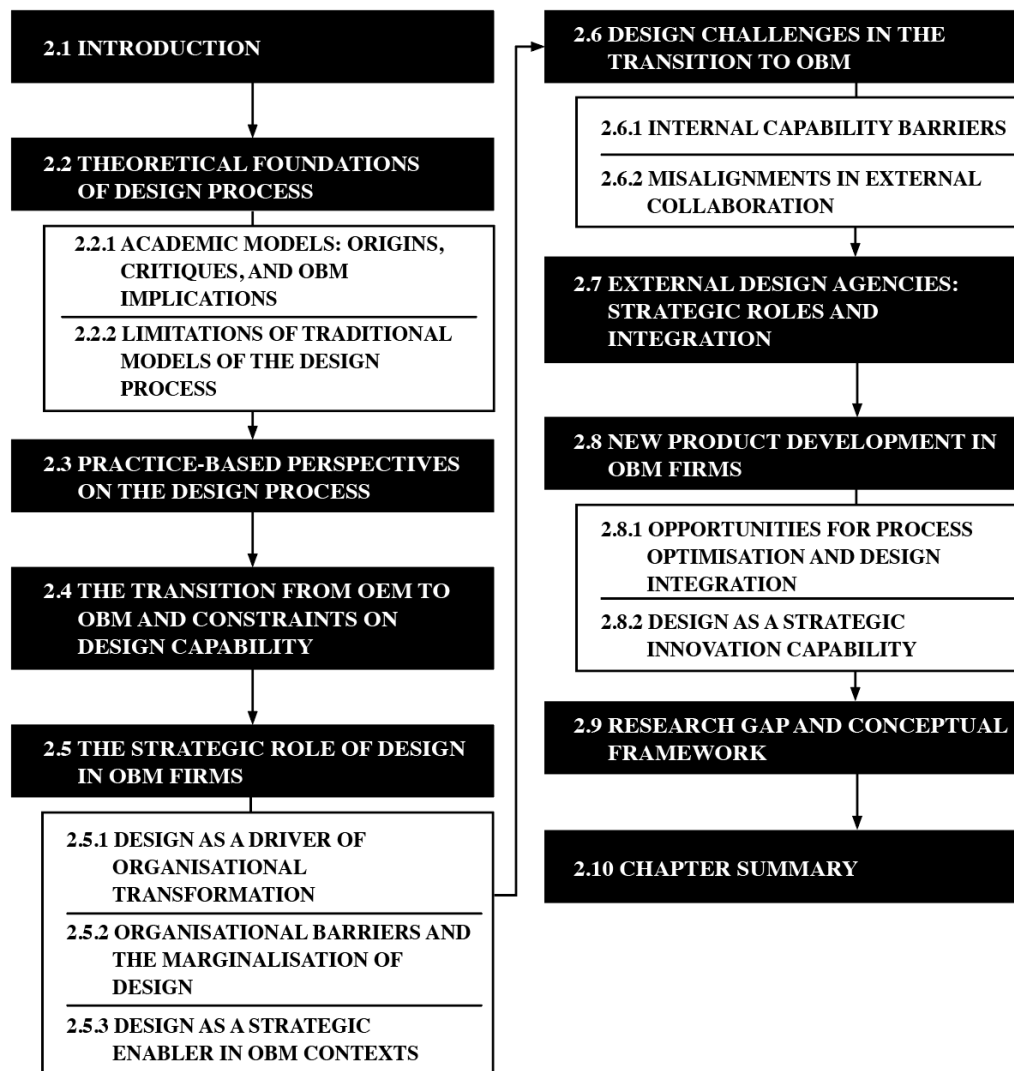
Subsequent sections explore the transition from OEM and ODM to OBM, focusing on how structural, cultural, and organisational constraints limit the development of design capability. The discussion further analyses the strategic role of design in driving organisational transformation, the barriers to its integration, and the challenges firms face in embedding design as a strategic resource.

Attention is also given to the role of external design agencies, whose collaborations with OBM firms often enhance creativity but rarely result in sustainable knowledge transfer or capability development. The chapter then considers NPD as a platform for design integration, examining how design can improve innovation performance yet remains insufficiently embedded in existing process frameworks.

Finally, the chapter identifies two major research gaps:

- (1) the lack of understanding of collaboration and knowledge transfer process between OBM firms and design agencies; and
 - (2) the absence of adaptive design processes responsive to different levels of design maturity.
- These insights form the theoretical basis for the conceptual framework developed in the next chapter.

Figure 2.1 Overview of the overall structure and procedural flow of this chapter.



[Figure 2. 1: Chapter map]

2.2 Theoretical foundations of design process

Understanding the theoretical foundations of design processes is critical for exploring how OBM firms can structure and optimise their NPD activities, particularly when engaging with external design agencies. In transitioning from manufacturing-centric to brand-driven models, OBM firms must adopt coherent, adaptable design process frameworks that accommodate cross-functional collaboration, support iterative development, and address increasing product complexity. To this end, this section critically reviews seminal design processes developed

between the 1960s and the 2020s, evaluating their conceptual evolution and practical relevance for OBM contexts.

Table 2. 1: Definitions and roles of design process in theoretical studies

Year		Definition of design process	Primary role
1968	Archer, L.B.	A logically structured procedure based on a design programme, rational steps, and management of incomplete information.	Establishes design as a science; provides a standardised, rational framework for repeatable and evaluable design outcomes.
1970	John Chris Jones	A divergent–transformative–convergent process expanding the problem space before resolving it.	Positions design as a cognitive activity involving exploratory thinking and option development.
1984	Moody, S.	A professional activity that intentionally controls form, configuration, and appearance, distinct from engineering.	Enhances innovation success by aligning design with user needs; positions design as a strategic and independent contributor to technological innovation.
1989	Walker	A practitioner-led model of conceptualisation, embodiment, detailing, and production.	Aligns design phases with real-world constraints of manufacturing and material practice.
1990	Lawson	A process focusing on the interpretive and cognitive strategies of designers.	Highlights iterative reasoning, user understanding, and reflective practices in design thinking.
1995	Ulrich & Eppinger	A comprehensive model spanning planning, concept generation, system design, and testing.	Integrates engineering, marketing, and design functions into a single cohesive development process.
1996	Pahl & Beitz	A systematic engineering design methodology structured through requirement clarification and decomposition.	Encourages modular design thinking and formal documentation practices.
1997	Ullman	A pragmatic, documentation-driven model structured as problem solving with refinement.	Supports product development with a focus on mechanical engineering and validation.
1992	Buchanan	Defines design as framing problems using symbolic, material, behavioural, and systemic dimensions.	Shifts design into the realm of humanistic inquiry and complex societal systems.
2000	Cross	A reflective model that links expert knowledge to exploration, generation, and communication.	Emphasises cognitive strategies and knowledge practices among professional designers.
2009	Ulrich & Eppinger	Team-based design approach for complex engineering: concept, refinement, validation.	Emphasises structured collaboration in fields like aerospace, defence, and public sector innovation.
2017	Nocolai B. Hansen	A material-centric process where physical and digital artefacts act as cognitive scaffolds in participatory design.	Mediates understanding, reveals tensions, and supports reflective collaboration; reframes materials as active agents within co-design processes.
2024	Saadi, J.I.	A constraint-driven, iterative process shaped through interactions between designers and generative design tools (GDTs).	Optimises quantitative outputs while enabling aesthetic diversity and creativity through human–AI interaction; informs education and tool development.

As illustrated in Table 2.1, the earliest conceptualisation of the design process as a rational, scientific endeavour was introduced by Bruce Archer (1968), who proposed a triadic structure comprising analysis, synthesis, and evaluation. Archer argued that the design process should be made explicit, reproducible, and analytically traceable to achieve scientific legitimacy. His

work positioned design within the emerging academic discourse, embedding it in procedural transparency and methodological rigour (Archer, 1965). This rationalist orientation provided the foundation for numerous engineering-based models that continue to inform industrial design education and practice.

A notable empirical extension of this rationalist paradigm was presented by Stanley Moody (1984), whose study of British technology firms demonstrated the strategic significance of industrial design when decoupled from engineering and aligned with user-centred values. Moody's research illustrated that design, when conceptualised as a distinct, form-defining function, enhances innovation performance and market competitiveness (Moody, 1984). Although initially overlooked in theoretical discourse, Moody's conclusions have since gained renewed attention amid contemporary emphases on design-driven innovation.

J. Christopher Jones (1970) extended Archer's logic into a cognitive frame by conceptualising design as a problem-exploration activity. His model emphasised divergence, transformation, and convergence, and posited that design is not merely a procedural activity but a method of transforming initial uncertainty into structured knowledge (Jones, 1970). This marked a shift toward epistemic inquiry and recognised the cognitive complexity underpinning design thinking.

David Walker (1989), in turn, advanced a practitioner-centric view by situating the design process within the material and craft dimensions of production. His model delineated stages of conceptualisation, embodiment, detailing, and manufacture, stressing that physical realisation is integral to the logic of design implementation (Walker, 1989). Walker's approach resonates with OBM firms, where the manufacturability and tangible expression of design are crucial in bridging concept and production.

Bryan Lawson (1990) redirected attention toward the internal reasoning mechanisms of the designer. His model, focused on ideation, development, and testing, highlighted the iterative and dialectical relationship between creative ideas and practical constraints. According to Lawson, design resides in the ongoing negotiation between conceptual innovation and real-world limitations (Lawson, 1990). This framing aligns well with OBM firms seeking to balance creative autonomy and engineering feasibility.

Ulrich and Eppinger (1995) offered a comprehensive product development model integrating planning, concept generation, system-level design, and prototyping. Rooted in engineering management, their framework emphasised cross-functional collaboration and coordination among design, engineering, and marketing. They asserted that structured design processes accelerate time-to-market and improve interdepartmental alignment, outcomes highly relevant for OBM firms with diverse internal stakeholders (Ulrich & Eppinger, 1995).

Pahl and Beitz (1996) expanded on this engineering perspective with a systematic model rooted in functional decomposition. Their linear framework begins with requirements clarification and culminates in detailed conceptual design, championing modularity, consistency, and functional clarity (Pahl & Beitz, 1996). While valuable for structured engineering environments, its rigidity can present challenges in design contexts requiring adaptability and creativity, features essential in OBM NPD processes involving external agencies.

A complementary approach was presented by Ullman (1997), who introduced a documentation-driven model that foregrounded traceability and formalisation. In mechanical design contexts, Ullman stressed that success depends not only on creative ideation but also on comprehensive documentation and process transparency (Ullman, 1997). This emphasis on accountability reflects the increasing procedural complexity faced by OBM firms managing outsourced design and global supply chains.

Simultaneously, Richard Buchanan (1992) reframed design from a humanistic and interpretive perspective. His schema of four orders, symbolic, material, behavioural, and systemic, positioned design as a meaning-making process embedded in social, cultural, and ethical contexts (Buchanan, 1992). Buchanan's interpretive turn shifted the discourse beyond functional efficacy, offering OBM firms a lens through which to understand brand expression, user experience, and systemic value creation.

At the turn of the millennium, Nigel Cross (2000) contributed insights into the expertise of professional designers. His four-stage model, exploration, generation, evaluation, and communication, emphasised the non-linear, heuristic nature of expert design behaviour. He argued that design expertise relies on tacit knowledge and visual reasoning rather than rigid procedures (Cross, 2000). For OBM firms, this understanding underscores the value of

engaging with experienced design partners capable of navigating ambiguity and synthesising diverse inputs.

These cognitive and interpretive insights were synthesised in the UK Design Council's Double Diamond model (2006), which delineates discovery, definition, development, and delivery phases through a structure of alternating divergent and convergent thinking. The model offers a clear framework for managing innovation in collaborative settings and is especially suitable for OBM firms managing multidisciplinary teams or working with external partners (Design Council, 2006).

In response to increasing product and systems complexity, Ulrich and Eppinger (2009) revised their model to incorporate collaborative execution and systems-level validation. Their updated framework emphasised the alignment of multidisciplinary teams, recognising that success in complex sectors such as aerospace or medical devices requires robust collaborative structures (Ulrich & Eppinger, 2009). This model holds significant relevance for OBM firms operating in high-risk or technologically advanced markets.

Entering the 2010s, theoretical discourse began to integrate participatory and materialist perspectives. Hansen (2017), in a study of participatory design processes, posited that design artefacts such as sketches and mock-ups serve as cognitive and communicative tools that mediate understanding and expose conflict. She argued that materials are not passive vessels but active participants in design cognition, prompting reflection and collaboration (Hansen, 2017). For OBM firms leveraging co-design or iterative prototyping with external agencies, this insight reinforces the strategic value of tangible design artefacts in aligning vision and execution.

Recent advances in digital tools and computational theory have further extended the scope of design process models. Hagen (2024) proposed a Design Process Language (DPL), suggesting that the semantic relationships between design concepts constitute the logical structure of design itself. His framework conceptualises design processes as machine-readable structures that can enable computational co-design, offering potential pathways for OBM firms seeking to integrate AI-enhanced design tools (Hagen, 2024).

Similarly, Saadi and Yang (2023) examined the influence of generative design tools (GDTs) on designers' cognition and creative behaviour. Drawing on empirical studies with both novice and experienced designers, they found that GDTs tend to emphasise quantitative performance criteria while qualitative and aesthetic considerations are addressed indirectly through designers' reflective engagement with the tools. Their findings highlight that aesthetic diversity and creative value emerge through iterative, reciprocal interaction between designer and system. These insights suggest that OBM firms adopting AI within their NPD workflows should maintain human-machine collaboration dynamics to sustain creativity and preserve brand distinctiveness.

These evolving design process models, from rationalist engineering frameworks to participatory, interpretive, and computational paradigms, highlight the multifaceted nature of design in contemporary contexts. For OBM firms, selecting or tailoring a design process framework requires careful consideration of organisational maturity, cross-functional integration, technological context, and the role of external design partners. As design becomes increasingly distributed across artefacts, people, and systems, it is not only a method of problem-solving but also a vehicle for knowledge production, strategic alignment, and value creation.

2.2.1 Academic models: origins, critiques, and OBM implications

Academic inquiry into the design process has generated a diverse body of theoretical models that elucidate its internal structure, underlying principles, and strategic potential. Over more than six decades, these models have not merely documented individual design practices but have identified generalisable structures that explain how design tasks unfold, how decisions are made, and how outcomes can be enhanced for efficiency, creativity, and organisational coherence (Jones, 1970; Cross, 2006; Wallace & Clarkson, 1999). Within the context of OBM firms, particularly those transitioning from production-oriented operations to innovation-led branding, understanding the theoretical evolution of these models is critical for configuring effective design practices and managing collaboration with external design agencies. Table 2.2 presents a comparative overview of key representative design process models.

Table 2. 2: Comparative overview of representative design process models

No.	Researcher	Design process (Summary)	Core concept and purpose	Principal contribution and distinctive features
(1)	Archer (1965)	Analysis – Synthesis – Evaluation	Delineates the design process into rational and sequential phases	Among the earliest attempts to systematise design as a logical and structured methodology
(2)	John Chris Jones (1970)	Divergence – Transformation – Convergence	Expands the problem space before converging upon viable solutions	Conceptualises design as an exploratory and creative cognitive structure
(3)	Moody (1984)	Form & Configuration Control → User Interpretation → Organisational Separation → Iterative Collaboration	Positions industrial design as a strategic function enhancing technology adoption by ensuring perceptual clarity and user alignment. Emphasises the need for structural independence of design in innovation processes.	Articulates design as a strategic enabler of technological innovation, focused on interpretability, usability, and cross-functional integration. Highlights design's role in reducing innovation risk through user-centred visual logic.
(4)	Walker (1989)	Conceptualisation – Embodiment – Detailing – Production	Integrates the design stages with the realities of manufacturing implementation	Emphasises design as a practitioner-led activity anchored in material realisation and technical craftsmanship
(5)	Lawson (1990)	Problem Definition – Problem Understanding – Ideation – Development – Testing	Focuses on the cognitive strategies employed by designers	Analyses the internal reasoning process of designers, foregrounding interpretive and iterative thinking
(6)	Ulrich & Eppinger (1995)	Planning – Concept Generation – System Design – Detailed Design – Testing	Offers a holistic product development model encompassing design, engineering, and marketing	Proposes an integrative framework for collaborative, cross-functional product development
(7)	Pahl & Beitz (1996)	Requirement Clarification – Conceptual Design – Embodiment Design – Detail Design	Presents a systematic engineering design methodology based on functional decomposition	Defines precise iterative design phases and encourages formal specification and modular thinking
(8)	Ullman (1997)	Requirement Definition – Concept Generation – Design Elaboration – Evaluation – Documentation	Structures mechanical design as a practical problem-solving sequence	Proposes a pragmatic, documentation-oriented approach tailored to mechanical product development
(9)	Buchanan (1992)	Four Orders of Design Framing: Symbolic – Material – Behavioural – Systemic	Reframes design as the act of defining and interpreting problems from a humanistic standpoint	Expands the scope of design thinking to encompass organisational, policy, and systemic challenges
(10)	Wallace & Clarkson (1999)	Task Clarification – Conceptual Design – Embodiment Design – Detail Design	Defines design as a knowledge- intensive, iterative process that translates market needs into implementable manufacturing instructions	Provides a structured yet adaptive engineering design model that integrates decision-making, documentation, evaluation, and cross-functional communication; bridges rational design with reflective practice
(11)	Cross (2000)	Exploration – Generation – Evaluation – Communication	Emphasises the unique knowledge practices inherent in expert design activity	Highlights iterative cycles and cognitive strategies of professional designers, grounded in empirical research
(12)	Design Council (2006) – Double Diamond Model	Discover – Define – Develop – Deliver	Provides a user-centred, dual- phase divergence–convergence model	Widely adopted in UX, service design, and public sector innovation for its clarity and adaptability
(13)	Unger & Eppinger (2011)	Problem Definition – Concept Generation – Design Refinement – Detailed Design – Validation	Develops a team-oriented design methodology for complex engineering systems	Practical model for collaborative design execution in high- complexity fields such as IT, aerospace, and manufacturing

1) Linear and stage-based models: foundations and constraints

One of the earliest and most influential contributions to design theory is the linear, or stage-based, model, which conceptualises design as a sequential progression through rationally ordered phases. Archer's (1965) triadic framework—analysis, synthesis, and evaluation—was among the first systematic attempts to formalise design as a scientific and repeatable process within the rationalist paradigm. This model promoted methodological clarity suitable for engineering and industrial contexts.

Building on Archer's foundation, Pugh (1991) proposed the Total Design model, which established an integrated process linking market identification, specification, concept generation, detailed design, manufacture, and sales. His framework explicitly connected design to commercial feasibility, bridging creative ideation and industrial implementation—an enduring concern for OBM firms seeking to align design and production capabilities.

Similarly, Ulrich and Eppinger (1995) developed a cross-functional product development framework encompassing planning, concept development, system-level design, detailed design, and testing. Their model, widely adopted in technology-intensive industries, ensured traceability, decision-gate control, and interdepartmental coordination. Pahl and Beitz (1996) reinforced this systematic approach through their four-stage model, clarification of requirements, conceptual design, embodiment, and detail development emphasising modularity and formal specification.

Wallace and Clarkson (1999) extended stage-based reasoning by integrating adaptive feedback loops and lifecycle alignment. Their model retained structural rigour while introducing responsiveness to change, making it particularly relevant for OBM firms managing complex engineering environments.

However, linear models have been criticised for oversimplifying the iterative, exploratory character of real-world design. Cross (2006) and Lawson (2006) argue that such frameworks neglect the abductive reasoning and intuitive judgement essential to creative design practice. In OBM contexts where brand storytelling, emotional value, and agile iteration are critical over-reliance on rational procedures may constrain innovation and diminish user-centred insight.

2) Iterative and divergent–convergent models: addressing complexity and exploration

To address the rigidity of sequential models, later theorists emphasised iteration, divergence, and exploration. Jones (1970) conceptualised design as a cognitive journey through divergence, transformation, and convergence, encouraging designers to expand and reinterpret the problem space before converging on solutions, an approach well suited to OBM firms confronting uncertain markets.

The UK Design Council's (2006) Double Diamond model formalised this process by structuring design into two divergent–convergent cycles: Discover–Define and Develop–Deliver. Its clarity has made it ubiquitous in UX, service design, and innovation policy. Nevertheless, subsequent scholars caution that its simplicity may obscure the socio-technical negotiations and power asymmetries of collaborative projects, particularly where external agencies are involved (Kochanowska et al., 2021; Ramsden, 2023).

Cross (2006) also described design as a cyclic process of exploration, generation, evaluation, and communication, grounded in the epistemic practices of expert designers. Complementing this, Ullman (1997) articulated a five-stage engineering design process, requirements definition, concept generation, design elaboration, evaluation, and documentation, emphasising documentation and accountability, qualities valued in regulated OBM sectors.

3) Cognitive and reflective models: recognising design as situated knowledge

Cognitive and reflective frameworks redefine design as a situated and interpretive practice. Lawson (2006) characterised design through iterative cycles of problem framing, ideation, development, and evaluation, highlighting the cognitive strategies and intuitive reasoning of skilled practitioners.

Schön (1983) advanced this orientation with his theory of the reflective practitioner, portraying design as a conversation between designer and situation mediated by reflection-in-action. This view rejects universal proceduralism and foregrounds tacit, experiential knowledge. For OBM

firms lacking mature internal design capacity, it underscores the importance of cultivating reflective sensibility rather than outsourcing creativity.

Buchanan (1992) expanded reflection to a systemic level with his “four orders of design”, symbolic, material, behavioural, and systemic framing design as meaning making across organisational and social domains. This perspective invites OBM firms to integrate design into broader strategies for innovation and societal impact.

4) Strategic and activity-centred models: design as an organisational asset

From the mid-1980s, design theory extended beyond process mechanics to strategic and organisational dimensions. Moody (1984) argued that industrial design must remain institutionally distinct from engineering to preserve user-centred innovation and perceptual coherence, emphasising design’s role in translating technology into human experience.

Wallace and Clarkson (1999) reinforced this organisational stance by embedding cross-functional feedback and communication mechanisms within engineering design, bridging conceptual abstraction and operational execution, a challenge central to OBM firms managing multi-stakeholder coordination.

Ulrich and Eppinger (2015) (updated from 1995) refined this systemic view through a model incorporating problem definition, concept generation, design refinement, detailed design, and validation. By foregrounding collaboration and information management across distributed teams, it applies particularly to OBM firms in regulated, high-technology sectors.

5) Design Thinking and Research-Oriented Models: Expanding Design’s Role

The global diffusion of Design Thinking, popularised by IDEO and Stanford’s d.school, broadened design’s definition to encompass empathy, ideation, prototyping, and feedback as mechanisms for organisational learning and innovation (Brown, 2009; Liedtka, 2015). It repositions design from an aesthetic service to a strategic method for problem-solving and cross-functional collaboration, encouraging OBM firms to embed experimentation within managerial practice.

Parallel to this, Design Research Methodology (DRM) by Blessing and Chakrabarti (2009) introduced a four-phase empirical structure; Research Clarification, Descriptive Study I, Prescriptive Study, and Descriptive Study II, linking academic rigour with applied design practice. Although demanding in data and process management, DRM provides a valuable template for OBM firms or partners seeking research-driven innovation.

6) Comparative evaluation and synthesis: towards an OBM-relevant framework

The historical evolution from Archer's scientific formalism to Buchanan's systemic humanism, from Jones's iterative exploration to Ulrich and Eppinger's engineering pragmatism, reflects design's expanding interdisciplinarity. Each tradition contributes distinct strengths: stage-based models offer procedural stability; iterative frameworks promote adaptability; cognitive models embed experiential expertise; and strategic approaches integrate design as an organisational capability.

Yet no single framework fully resolves the complexities faced by OBM firms reliant on external design consultancies. Structural constraints, limited design literacy, and resource scarcity often impede implementation of highly formal or fragmented models.

Accordingly, a hybrid model is required, one combining

- the rigour and traceability of structured engineering design (Ulrich & Eppinger, 2015; Wallace & Clarkson, 1999),
- the feedback orientation of iterative frameworks (Jones, 1970; Cross, 2006; Dorst & Cross, 2001),
- the cognitive insight of reflective models (Lawson, 2006; Schön, 1983), and
- the strategic alignment of design-led management perspectives (Moody, 1984; Buchanan, 1992; Brown, 2009; Liedtka, 2015).

Such a framework should be operational within resource-constrained environments, enabling early collaboration, shared decision checkpoints, lightweight iteration tools, and managerial structures that align design activity with brand and market strategy.

The theoretical progression of design process research thus reveals a fragmented yet cumulative field. While stage-based methodologies provide procedural control, they are

insufficiently responsive to the dynamic, collaborative, and interpretive realities of OBM firms. Iterative, cognitive, and strategic approaches address these gaps but often lack structural coherence for consistent execution.

The challenge for OBM firms, and for design theorists and policymakers is to construct integrated, modular, and context-sensitive frameworks that institutionalise design as a strategic capability. Future research should empirically validate such hybrid models, focusing on OBM–agency collaboration, cross-functional decision-making, and the scalability of design interventions within small and medium-sized enterprises.

2.2.2 Limitation of traditional models of the design process

Over the past several decades, design process models have evolved through extensive academic theorisation and iterative refinement in practice. Nevertheless, many traditional models retain inherent limitations such as linear thinking, structural rigidity, and contextual insensitivity. These constraints substantially diminish their explanatory and operational relevance within the complex, interdisciplinary realities of contemporary design practice. As a result, recent design scholarship has increasingly moved beyond single-model paradigms, advocating instead for multilayered, adaptive, and meta-integrative frameworks that reflect the situated and dynamic nature of design activity. This study thus examines the structural and practical shortcomings of conventional design models and, through engagement with the work of key scholars, argues for the development of adaptive, synthesised frameworks for modern design contexts.

Bahrami and Dagli (1993) explicitly contend that despite decades of accumulated research since the 1950s, no universally applicable design model has been established. They argue that design cannot be reduced to a fixed procedural sequence but must be understood as a complex, multilayered activity. Accordingly, they advocate for comparative and interoperable frameworks that facilitate the manipulation of multiple partial models according to situational demands. Their perspective underscores the context dependency and inherent uncertainty of design, shifting the emphasis from uniformity toward compatibility and adaptability.

Clarkson and Eckert (2004) further elaborate on this systems-oriented view by conceptualising design complexity as the interaction among four interdependent dimensions: product structure,

design process, organisational system, and external context. They maintain that a single model is structurally incapable of encompassing this multidimensional complexity and instead call for meta-frameworks capable of integrating and coordinating multiple design models in parallel.

More recently, Krüger, Gericke, and Zorn (2024) provide empirical evidence from industrial practice, demonstrating that the simultaneous application of heterogeneous design models frequently results in inconsistency, methodological conflict, and practitioner resistance. In response, they propose the Integrated Function Modelling (IFM) framework as an integrative strategy to reconcile fragmented methodologies and improve implementation feasibility by aligning conceptual and operational structures across models.

Meanwhile, Winter (2007) critiques the rigidity of fixed process architectures and proposes Situational Method Engineering (SME) as a flexible design strategy that enables the dynamic configuration of process components according to contextual demands. This approach decomposes the design process into modular activity units that can be reassembled based on an organisation's strategic orientation, project scope, and stakeholder needs. In doing so, Winter introduces the concept of a "designable design process", a paradigm in which the process itself becomes a subject of design, capable of continual reconfiguration and improvement.

Building upon this adaptive logic, Fischer and Giaccardi (2006, 2017) advance the notion of meta-design, arguing that design should not be treated as a static deliverable but as an evolving platform in which users and systems co-develop over time. They emphasise the value of open-ended, reconfigurable structures established from the earliest design stages, ensuring that users remain empowered to reinterpret, extend, and reshape systems beyond their original instantiation.

Maier, Eckert, and Clarkson (2017) further examine the operational implications of model design by analysing how the granularity of a design model directly influences its practical utility and implementation success. They argue that models that are either overly simplistic or excessively complex risk distorting information and impeding execution. Effective design modelling, therefore, requires a balanced level of abstraction and clearly defined hierarchical relationships. Moreover, for cross-model integration to be viable, meta-information, such as

abstraction level, phase coverage, and intended use, must be explicitly defined, ensuring interoperability and methodological consistency across diverse design frameworks.

Kanno and Shibata (2013) expand the discussion to the organisational dimension, asserting that design must function not merely as an aesthetic contribution but as a core strategic capability driving innovation and competitive differentiation. They contend that the design process should be positioned at the centre of organisational decision-making, coordinating cross-functional collaboration and shaping strategic judgement. For this integration to be effective, design teams must be institutionally embedded within governance and decision structures with the authority to influence key outcomes. This organisationally embedded model of design aligns conceptually with Winter's situational method engineering and Krüger et al.'s (2024) function-based meta-framework, illustrating that institutional integration and adaptability are decisive determinants of design's strategic impact.

Through this synthesis, the study highlights the structural rigidity and implementation constraints that have historically limited the efficacy of traditional design process models. The literature collectively demonstrates the necessity of adaptive and integrative design approaches capable of reconciling complexity, accommodating contextual variation, and fostering participatory engagement. The assumption of universal applicability embedded within singular design models is increasingly untenable. Instead, contemporary design practice demands multi-scalar, context-sensitive frameworks that align with the evolving socio-technical and organisational realities of OBM firms.

Approaches such as those proposed by Winter (2007) and Krüger et al. (2024) provide tangible strategies for operationalising adaptability in the design process. Winter's concept of *Situational Method Engineering* enables the process itself to become an object of design, configurable and responsive to contextual variation, while Krüger et al.'s *Integrated Function Modelling* (IFM) framework offers a mechanism for reconciling heterogeneous models through functional integration. Together, these perspectives establish the methodological foundations for achieving consistency and flexibility within complex organisational environments.

The complementary theories of Fischer and Giaccardi (2006, 2017) in *meta-design*, Maier et al. (2017) in *model granularity*, and Kanno and Shibata (2013) in *organisational design strategy* extend this adaptability across the user, structural, and institutional dimensions of

design. Fischer and Giaccardi position design as an evolving platform that enables continual co-evolution between systems and users; Maier et al. highlight the importance of balancing abstraction and detail to ensure interoperability across models; and Kanno and Shibata emphasise the institutional embedding of design as a strategic coordination mechanism within corporate decision-making structures. Collectively, these frameworks converge on a shared principle: that design must function as a dynamic, integrative system rather than a static sequence of procedures.

The design process should no longer be conceived as a linear, problem-solving methodology but as an enterprise-wide execution framework that interweaves cognitive flexibility, systems logic, and managerial strategy. As Kanno and Shibata (2013) assert, for firms seeking differentiation in oversaturated markets, design must be institutionalised not merely as a creative instrument but as a core organisational function. This integrative paradigm positions design as a strategic capability capable of shaping user experience, brand identity, and long-term corporate direction. Ultimately, such a shift requires viewing design as an adaptive system, one that clarifies and consolidates its strategic role within the broader architecture of twenty-first-century enterprise.

2.2.3 Theoretical perspectives on organisational design capability and learning

While the preceding sections have examined the evolution and limitations of design process models, these perspectives alone do not sufficiently explain how design is effectively integrated within organisational contexts, particularly in OBM firms. As indicated in later discussion chapters, design processes are not implemented as isolated procedural systems but are shaped by organisational capabilities related to knowledge acquisition, learning, coordination, and adaptation. To address this gap, this study adopts a complementary theoretical perspective grounded in absorptive capacity, organisational learning, design management, and dynamic capabilities. Together, these perspectives provide a conceptual basis for understanding how design capability develops and how CDPs are enacted within industrial organisations.

Absorptive capacity, as defined by Cohen and Levinthal (1990), refers to a firm's ability to recognise the value of external knowledge, assimilate it, and apply it to commercial outcomes. This perspective is particularly relevant in contexts where firms engage with external design

agencies. Prior research suggests that the effectiveness of such collaborations depends not only on the quality of external input but also on the internal capacity of the organisation to interpret and utilise that knowledge. In the context of OBM firms, this implies that design outcomes are contingent upon the organisation's ability to internalise externally generated design insights rather than simply adopt them at a superficial level.

Organisational learning theory further explains how such knowledge becomes embedded within the firm over time. Argyris and Schön (1996) distinguish between single-loop learning, which involves incremental adjustments within existing routines, and double-loop learning, which entails the reconsideration of underlying assumptions. This distinction is particularly relevant for design integration, where effective capability development often requires changes not only in procedures but also in organisational mindset and decision-making structures. From this perspective, design capability can be understood as an outcome of iterative learning processes, supported by reflection, feedback, and cross-functional interaction.

Design management theory provides an additional lens by positioning design as an organisational and strategic resource. According to Borja de Mozota (2003), design contributes value when it is aligned with business objectives and integrated across operational, functional, and strategic levels. This perspective is particularly relevant for OBM firms transitioning from OEM or ODM models, where design has traditionally been treated as a downstream activity. The integration of design into organisational decision-making therefore depends on managerial structures and coordination mechanisms that enable design to function beyond aesthetic refinement.

Dynamic capabilities theory extends this perspective by framing design capability as an adaptive and evolving organisational resource. Teece, Pisano, and Shuen (1997) define dynamic capabilities as the firm's ability to integrate, build, and reconfigure internal and external competences in response to changing environments. In the context of design, this suggests that design capability develops through continuous interaction between internal learning and external collaboration, rather than through the adoption of fixed processes. This perspective is particularly useful for understanding how OBM firms adjust their design practices over time in response to shifting market and technological conditions.

These perspectives extend the understanding of design processes beyond procedural models by introducing an organisational and capability-based dimension. Absorptive capacity explains the conditions under which external design knowledge can be internalised, organisational learning clarifies how design practices are embedded through iteration, design management theory positions design as a coordinated strategic resource, and dynamic capabilities emphasise the adaptive nature of design capability. These theories provide a conceptual foundation for interpreting the empirical findings and understanding design as an evolving organisational capability rather than a fixed methodological sequence.

This theoretical framing also establishes a foundation for examine design maturity, particularly through the Danish Design Ladder, where explains how varying levels of organisational readiness shape the role of design and the structure of CDPs.

2.3 Practice-based perspectives on the design processes

Recent scholarship in industrial and product design has increasingly shifted from prescriptive, model-based paradigms toward practice-based frameworks that reflect the complex, context-specific realities of professional design work. Practice-based research prioritises empirical inquiry into the lived experiences, decision-making processes, and iterative routines of designers operating within organisational environments. Rather than imposing top-down theoretical structures, it seeks to derive insight from how design is performed, embedded within business constraints, technological infrastructures, and interdepartmental collaboration. This approach bridges theory and practice by recognising design as a situated, socially and materially mediated activity.

Table 2. 3: Comparative overview of representative practice-based design processes

No.	Researcher	Design process definition	Primary role	Comparative highlights
(1)	Hayes & Wheelwright (1979)	Product–Process Matrix (PPM) aligning product structure with manufacturing process characteristics.	Strategic alignment of design and manufacturing for operational planning and competitiveness.	Focuses on manufacturing–product alignment at strategic level; foundational operations tool.
(2)	Pugh (1990)	Total Design model covering from market need identification to product delivery, using the Concept Selection Matrix.	Cross-functional integration of design activities for structured decision-making and enterprise-wide innovation	Introduces cross-functional concept selection in early-stage design; supports enterprise integration.
(3)	Norman (1988/2013)	User-Centered Design (UCD) based on affordances,	Informs consumer-oriented design using principles from	Highlights psychological and behavioural aspects;

		feedback, and cognitive alignment in interface design.	cognitive psychology and user perception.	user perception central to design logic.
(4)	Vidner, Wehlin & Wiberg (2022)	Integration of Design Automation (DA) and Design Optimisation (DO) in CAD and configuration tasks.	Improves design efficiency and standardisation while addressing organisational adaptation challenges.	Centres on automation and optimisation; shifts routine work to systems, raising change management needs.
(5)	Schweitzer, Gloor & Coughlan (2023)	Five-stage Design Thinking (DT) model implementation in innovation contexts.	Reveals DT's practical barriers and stresses the importance of context-driven application.	DT as a structured, staged innovation method; criticised for internal barriers and implementation gaps.
(6)	Zolghadri, Pellerin & Bernard (2023)	PLM-based integration of product and manufacturing design for system-level alignment.	Emphasises digital convergence, data synchronisation, and team coordination for agile design execution.	Adds digital system integration (PLM); enhances real-time collaboration and agility in design–production link.
(7)	Tapia, Pradel & Bibb (2024)	Empirically derived model showing design shaped by technological, strategic, and client-related constraints.	Practice-based lens on industrial design influenced by agile tools, digital methods, and organisational culture.	Depicts design as shaped by evolving tools, client needs, and workplace culture; non-linear approach.

One of the earliest and most influential contributions to practice-oriented design research is the Product–Process Matrix (PPM) introduced by Hayes and Wheelwright (1979), as summary illustrated in Table 2.3. Their framework maps the dynamic alignment between product structure (such as variety, customisation, and production volume) and manufacturing process characteristics (including automation and flexibility). This empirical matrix enables firms to evaluate and select operational strategies according to product maturity and complexity. Beyond serving as a strategic typology, the PPM functions as a practical alignment tool for synchronising design and manufacturing processes. Hayes and Wheelwright argue that competitive advantage in cost, quality, and responsiveness emerges when an organisation operates along the diagonal of the matrix, where product and process achieve optimal equilibrium.

Expanding the strategic focus to encompass design execution, Pugh's (1990) Total Design framework presents a fully integrated model that spans market need identification through to final product delivery. This approach reframes design as a cross-functional organisational process involving marketing, engineering, finance, and production rather than an isolated technical function. Central to Pugh's model is the Concept Selection Matrix, a decision tool that systematises concept evaluation and supports structured iteration. His emphasis on collaborative engagement and systematic coordination exemplifies how design processes can function as enterprise-wide mechanisms for innovation, coherence, and value creation.

A complementary, user-centred practice-based stream is represented by Norman's (1988; rev. 2013) seminal work *The Design of Everyday Things*. Norman reconceptualises design as a cognitively aligned, iterative process grounded in principles of affordance, feedback, and mapping. Drawing upon analyses of real-world product failures, he introduces User-Centred Design (UCD) as both a philosophy and a procedural framework through which user perception and behaviour directly inform design decisions. His work remains foundational to product interaction design, illuminating how cognitive psychology underpins design rationale in consumer-oriented industries.

In a contemporary context, Tapia, Pradel, and Bibb (2024) extend practice-based inquiry through qualitative investigation of UK industrial design practitioners. Using semi-structured interviews and participatory workshops, they demonstrate that industrial design is not a linear or purely aesthetic endeavour but an activity mediated by technological contingencies, client negotiation, strategic alignment, and organisational culture. Their study reveals how contemporary design practice adapts to digital tools, agile methods, and shifting team structures, providing an empirically grounded lens for understanding design as a negotiated and evolving process within real-world constraints.

Complementing these conceptual advances, Vidner, Wehlin, and Wiberg (2022) investigate the integration of Design Automation (DA) and Design Optimisation (DO) systems across five European manufacturing firms. Their multi-case study demonstrates that automating repetitive design activities, particularly in CAD modelling and product configuration, enhances process efficiency, accuracy, and cross-departmental standardisation. Crucially, however, the study highlights that such integration must address organisational resistance, skill adaptation, and workflow realignment, reframing automation not as a mere technical overlay but as a transformative dimension of the design process itself.

Similarly, Seidel and Fixson (2013) investigate the organisational adoption of Design Thinking (DT) within innovation-oriented firms. Drawing upon extensive empirical research, they conceptualise DT as an iterative practice involving problem framing, ideation, prototyping, and testing, while identifying the organisational factors that constrain or enable its implementation. Their findings reveal that cognitive biases, unclear process ownership, and entrenched managerial routines often hinder institutionalisation, underscoring the necessity of embedding

design frameworks within existing organisational structures and cultures to ensure sustained impact (Seidel & Fixson, 2013).

At a systems level, Zolghadri, Pellerin, and Bernard (2023) explore Product Lifecycle Management (PLM)-based integration of product and manufacturing design. Their review synthesises data flows, tool interconnectivity, and cross-team collaboration to demonstrate how digital convergence enables the synchronisation of design intent with manufacturing execution. They conclude that seamless data exchange, shared visibility, and robust communication architectures are critical to enhancing design agility and responsiveness within complex industrial ecosystems.

Collectively, these studies affirm that industrial design processes cannot be comprehensively understood through abstract or prescriptive models alone. Instead, design must be situated within the lived realities of professional practice, mediated by organisational structures, socio-political dynamics, and technological systems. The literature consistently reinforces that design is not a fixed or universal methodology but an adaptive, integrated, and context-sensitive process. Its success depends as much on interdepartmental coordination, digital infrastructure, and cultural alignment as on methodological rigour or creative capability.

Crucially, these insights reposition design not merely as a downstream function concerned with product form or usability but as a strategic organisational capability that underpins systemic innovation and sustained competitiveness. For both researchers and practitioners, adopting practice-based perspectives provides a pathway to reconceptualise design as a framework for shaping the organisational and technological systems through which enduring value and differentiation are achieved.

2.4 The transform from OEM to OBM and constraints in design capability

During the early stages of industrialisation, newly industrialising economies (NIEs) in East Asia, including South Korea, Taiwan, Singapore, and Hong Kong, pursued industrial growth through a strategy of OEM for established Western brand-owning firms (Figure 2.2). Emerging

prominently in the 1960s, this development pathway was designed to accelerate technological learning, build export competitiveness, and stimulate national economic advancement. As Kim and Nelson (2000) observe, the OEM model originated in the 1950s and 1960s when U.S. computer manufacturers began outsourcing production to East Asian subcontractors. This structure allowed resource-constrained latecomer firms to integrate into global production networks, exploit comparative advantages in labour cost, and acquire tacit knowledge through sustained collaboration with foreign clients (Yan, Chiang, & Chien, 2014).

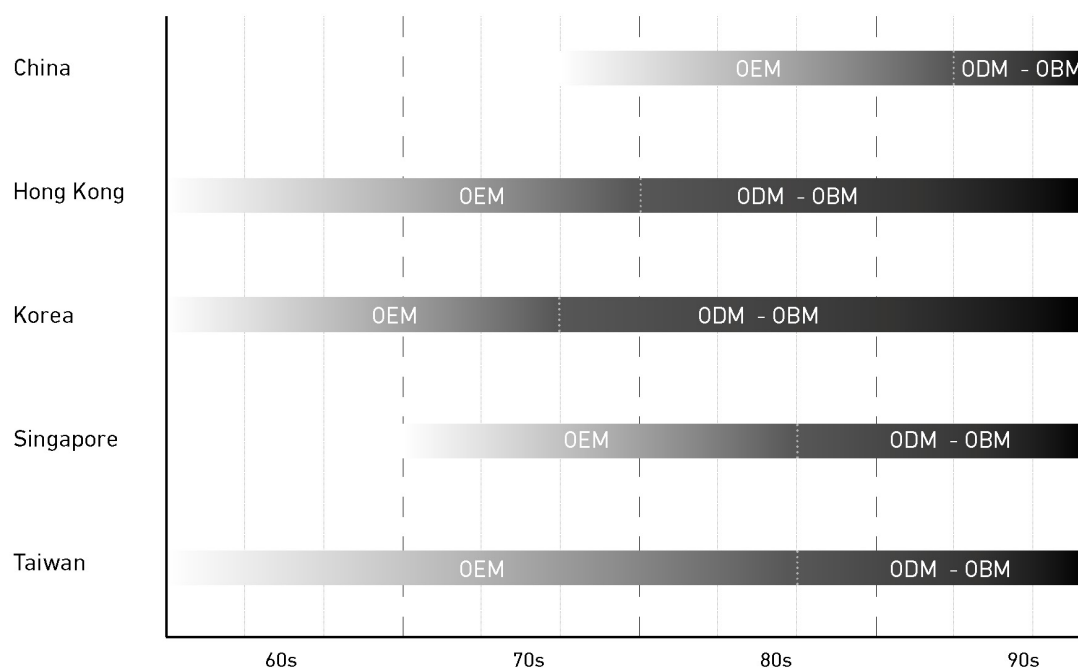


Figure 2. 2: Timeline for transition of NIE latecomer countries: From OEM to ODM to OBM

Mathews (2002) characterises such latecomer firms as resource-poor but strategically oriented toward catch-up, often leveraging cost advantages to penetrate international markets. Concentrated in labour-intensive industries such as electronics, these firms relied on manufacturing efficiency rather than innovation capability. Initially, this OEM-based growth model enabled rapid accumulation of production experience and economies of scale. However, over time, rising wages and inflation eroded these comparative advantages, forcing firms to pursue higher-value functions within the supply chain.

Table 2. 4: Transition of latecomer firms from OEM to ODM to OBM (Hobday, 1995)

	OEM – 1960s/1970s	ODM – 1980s	OBM – 1990s
Technological transition	Learns assembly process for standard, simple goods	Learns design and product innovation skills	Designs new products and conducts R&D
Market transition	Foreign transitional corporation (TNC) designs, brands and distributes	Foreign transitional corporation (TNC) buys, brands and distributes TNC gains post-production value added (PPVA)	Local firm invest in distribution, branding gains post-production value added (PPVA)

The subsequent progression from OEM to ODM and ultimately to OBM represents what Hobday (1995) terms the conventional upgrading trajectory (Table 2.4). Hobday conceptualised this process as a multidimensional learning pathway that extends beyond production efficiency to include the internalisation of design, branding, and marketing capabilities. Yet, while many firms attempt this transition, only a small number succeed in achieving sustainable OBM status due to structural constraints, limited design competence, and strategic misalignment.

By definition, OEM firms act as subcontractors that manufacture products in accordance with detailed specifications provided by external brand owners. Their competitive advantage derives primarily from production efficiency, scale, and cost competitiveness (Gereffi, 1999; Hobday, 1995). However, as Gereffi (1999) observes, value appropriation in global production networks remains highly asymmetric: most brand equity and profit accrue to client firms, leaving OEMs confined to low-margin operations. However, as Gereffi (1999) notes, value appropriation in global production networks remains highly asymmetric: most brand equity and profit accrues to client firms, leaving OEMs confined to low-margin operations. As production costs rise within NIEs, Western and Japanese brand owners often relocate OEM and ODM activities to lower-cost regions, perpetuating cycles of geographic displacement and cost arbitrage.

For OEM and ODM firms in NIEs, this dynamic creates a critical inflection point, whether to remain locked in cost-based competition or to evolve into OBM enterprises capable of capturing higher value through proprietary design and brand ownership. The shift to OBM thus represents not only a strategic choice but an economic necessity. Yan, Chiang, and Chien (2014) argue that only OBM firms possess the capacity to sustain profit growth by leveraging distinctive technologies, original design capability, and accumulated brand equity.

However, as Amsden and Chu (2003) emphasise, the pace of competitive upgrading in East Asia is exceptionally demanding. Firms must continuously enhance capabilities to avoid marginalisation by both high-end incumbents with strong intellectual property and low-end rivals competing on cost. Empirical evidence from Taiwan's electronics sector illustrates how firms are persistently "squeezed" between technological leaders and emerging low-cost producers. Within this environment, the development of design capability, the ability to integrate aesthetic, functional, and strategic considerations into product and brand development, becomes a decisive factor in achieving successful OBM transformation.

China's industrial trajectory offers a compelling illustration of the challenges and possibilities inherent in the OEM-to-OBM transformation. Firms such as Huawei, Lenovo, TCL, and Haier began as OEMs or ODMs before seeking to establish proprietary brands and global distribution networks. Their development was supported by government-led technology transfer programmes, foreign joint ventures, and the consolidation of state-owned assets into large enterprise groups. Despite these advantages, the transition has been uneven. The case of China's mobile communications firms illustrates the complex challenges of the OEM-to-OBM transition. Companies such as Eastcom, which initially served multinational clients like Motorola, attempted to establish proprietary brands but struggled with internal inefficiencies, limited design capability, and managerial rigidity. As a result, several reverted to OEM operations, exemplifying the broader difficulty of achieving OBM transformation without robust in-house design and strategic coordination (Hobday, 1995; Mathews, 2002).

Among the most critical barriers to successful OBM transformation is the lack of in-house design competence. OBM firms must differentiate not only through technical performance but also through emotional appeal, cultural resonance, and coherent brand expression (Veryzer & Borja de Mozota, 2005). Historically, however, many East Asian manufacturers have prioritised production efficiency over creative exploration, resulting in underdeveloped internal design functions and limited strategic understanding of design's value within corporate structures.

To compensate for these deficiencies, many firms outsource design to external consultancies. While outsourcing can accelerate development and introduce advanced design methodologies, it also presents structural challenges. External designers may lack familiarity with a firm's technological foundations, product philosophy, or organisational culture. This disconnect can

result in designs that are aesthetically refined yet strategically inconsistent. Moreover, the iterative cycles of feedback and revision inherent in external collaborations can extend development timelines and escalate costs. Industry evidence suggests that outsourcing design and manufacturing can substantially compress product development timelines. However, such dependency often reduces opportunities for internal learning, weakens organisational cohesion, and undermines the development of sustained design capability (Czarnitzki & Thorwarth, 2012).

Consequently, OBM firms must consider internalising design capabilities as a cornerstone of their competitive strategy. This entails recruiting professional designers, fostering cross-functional collaboration between design and engineering teams, and embedding design thinking into organisational culture. The management of external partnerships must also evolve beyond transactional engagement. As Czarnitzki and Thorwarth (2012) and Laplume and Srivastava (2014) argue, external design contributors should not merely provide aesthetic enhancement but must align their work with the firm's strategic and brand objectives. Similarly, Bruce, Cooper, and Vazquez (1999) caution that when external designers are engaged in limited or non-integrated roles, the outcomes often remain superficial, failing to contribute meaningfully to innovation or organisational learning.

The strategic progression from OEM to OBM thus represents a pivotal inflection point for latecomer firms. While OEM and ODM models provide the foundation for manufacturing expertise and export expansion, they do not ensure long-term sustainability amid escalating costs and global competition. OBM offers the potential for greater value capture, brand autonomy, and strategic independence, but only for firms capable of cultivating design as a core organisational capability. In this regard, design should be recognised not merely as a creative or functional adjunct but as a strategic lever for differentiation, customer engagement, and sustainable growth. Without substantive investment in design capability, whether internally developed or strategically integrated through partnerships, the OBM transition risks remaining aspirational rather than transformative.

2.5 The strategic role of design in OBM firms

OBM occupies a distinctive position within global value chains, assuming responsibility not only for production but also for product conception, design, branding, and market communication. Unlike OEMs and ODMs, which primarily serve external brand owners, OBMs must integrate innovation, user experience, and strategic identity into the products they develop and commercialise. This shift from production-oriented efficiency to brand-led innovation necessitates deep organisational transformation, particularly through the internalisation and strategic deployment of design capabilities.

2.5.1 Design as a driver of organisational transformation

The evolution from OEM to OBM represents more than a structural transition; it signifies a multidimensional organisational transformation encompassing strategic reorientation, capability accumulation, and cultural realignment. As Bruce and Morris (1994) and Veryzer (1995) argue, design within OBM firms should not be reduced to aesthetic enhancement or surface styling but recognised as a strategic capability that links technological innovation with market and user understanding. In this view, design functions as a mechanism for translating abstract brand values and user insights into coherent, tangible experiences that embody differentiation and meaning.

Li and Kozhikode (2008), in their analysis of latecomer firms such as Huawei and ZTE, underscore the growing strategic importance of design as companies ascend from OEM through ODM to OBM. While their study does not focus explicitly on design processes, it implicitly recognises design as a pivotal capability enabling responsiveness to user expectations and facilitating brand differentiation. As these firms mature, design evolves from a peripheral support activity to a core organisational function that integrates aesthetics, usability, and system-level innovation within broader business strategy.

This conceptual trajectory is empirically supported by Wang and Wu (2012), whose study of Taiwanese high-technology enterprises demonstrates that OBM firms deploy design not only for product enhancement but as a fundamental component of innovation and marketing strategy. Their findings reveal that firms with greater design integration achieve higher R&D productivity and greater returns on innovation investment, particularly when design operates in synergy with brand-led strategic planning.

Nevertheless, the integration of design into OBM structures remains a complex and contested process. Walsh et al. (1992) describe the OEM-to-OBM shift as an evolutionary progression characterised by iterative learning, organisational adaptation, and cultural change. In many transitioning firms, design is initially perceived as an auxiliary or decorative activity, leading to its marginalisation within decision-making hierarchies. Designers are often engaged late in the product development cycle, which restricts their strategic influence and limits design's potential to shape upstream innovation and brand direction. Overcoming this legacy requires not only capability development but also a paradigm shift in managerial cognition, recognising design as an organisational knowledge process that bridges creativity, production, and strategic intent.

In this light, design assumes a dual role within OBM firms: as a transformative agent that drives organisational learning and as a strategic integrator that aligns innovation, brand identity, and user experience. Embedding design within corporate strategy thus represents both a structural and cultural undertaking, one that redefines how firms conceive, develop, and communicate value in increasingly competitive markets.

2.5.2 Organisational barriers and design marginalisation

A recurring concern in the literature on OBM transition is the persistent marginalisation of design within organisational structures. Tsai and Hung (2010) observe that many Taiwanese electronics firms seeking to develop OBM models failed to align their internal design functions with core business strategies. In these firms, design departments frequently operated in isolation, excluded from strategic deliberations and deprived of decision-making authority. Similarly, Zhang and Zhang (2012) found that Chinese manufacturing firms often lacked the organisational culture and systemic mechanisms necessary to sustain design-led innovation. In such contexts, design tended to be confined to visual styling or branding rather than established as a user-centred, cross-functional process.

Walsh et al. (1992) reinforce this argument, contending that internalising design capability requires not only technical competence but also a profound cultural transformation. For firms historically shaped by OEM logic, where success is measured in efficiency, reliability, and

client satisfaction reorienting the organisation around creativity, empathy, and experiential quality poses a major challenge. Such transformation necessitates changes in managerial cognition, workflow structures, and performance metrics. The effectiveness of design integration therefore depends on a firm's cultural receptivity to new paradigms and its capacity to restructure communication channels, hierarchies, and feedback systems to accommodate iterative, design-driven practices.

Despite the growing recognition of design's strategic importance, OBM firms continue to face three interrelated barriers: limited absorptive capacity, underdeveloped organisational infrastructure for design, and weak mechanisms for customer-centred innovation (Li & Kozhikode, 2008). First, many latecomer firms struggle to assimilate external knowledge, whether derived from users, markets, or design consultancies because of inadequate learning mechanisms. Second, design remains under-institutionalised, with few structured processes that enable design knowledge to influence strategic decision-making. Third, the absence of systematic feedback loops prevents user insights from being effectively integrated into product development, thereby undermining iterative learning and constraining sustained innovation. Collectively, these limitations reflect a structural inertia that prevents design from evolving beyond an operational role into a fully strategic capability.

2.5.3 Design as a strategic enabler in OBM contexts

When effectively integrated, design functions as a strategic intermediary that bridges technological capabilities and market needs, enabling OBM firms to navigate increasingly complex and competitive environments. As Walsh et al. (1992) argue, design mediates between customer expectations and technological potential by translating intangible user insights into tangible product and brand outcomes. In this role, design operates both as a creative discipline and as an organisational interface that aligns internal competencies with external expectations, thereby enhancing coherence across strategy, innovation, and user experience.

External collaboration similarly plays a pivotal role in fostering internal design maturity. Walsh et al. (1992) illustrate that many Taiwanese firms initially operating as OEMs advanced toward OBM status through sustained partnerships with Western clients, which facilitated the transfer of user-centred design methodologies and process discipline. However, such transitions are rarely linear or automatic. Their success depends on deliberate investment in design talent,

institutional mechanisms, and structured systems that enable continuous learning from collaborative engagement.

For OBM firms working with external design consultancies, the principal challenge lies in overcoming procurement-oriented outsourcing models that reduce design to a transactional output. Instead, external designers should be involved at the earliest stages of strategy formulation and concept exploration so that their insights inform not only product form but also brand positioning and user narrative. The strategic effectiveness of such collaboration depends on the firm's absorptive capacity, managerial commitment to co-creation, and the degree to which design is integrated into broader organisational decision-making processes (Tsai & Hung, 2010; Wang & Wu, 2012).

The shift to OBM status therefore represents more than a functional diversification; it entails a fundamental reorientation of how firms perceive, manage, and leverage design. The literature consistently demonstrates that design serves as a central mechanism for shaping innovation trajectories, competitive positioning, and customer experience (Bruce & Morris, 1994; Walsh et al., 1992; Wang & Wu, 2012). Yet its organisational integration remains uneven, constrained by institutional inertia, cultural resistance, and structural fragmentation.

Future advances in OBM competitiveness will depend on cultivating design-informed leadership, strengthening cross-functional collaboration, and implementing adaptive processes that mirror the iterative and collaborative nature of modern product development. These themes are examined in subsequent chapters through empirical analyses of OBM case studies and design agency collaborations, which together inform a theoretically grounded yet practically adaptable design process.

2.5.4 Design maturity and the Danish Design Ladder (DDL)

The increasing recognition of design as a strategic resource in product development has led to growing interest in how organisations differ in their ability to integrate and utilise design effectively. While prior research has extensively examined design processes and design management, comparatively less attention has been given to design maturity. Design maturity can be understood as the extent to which design is systematically integrated into organisational

structures, processes, and decision-making activities, reflecting its role beyond a functional or aesthetic contribution towards a broader organisational capability (Borja de Mozota, 2003). Rather than being confined to isolated design tasks, higher levels of design maturity indicate that design is embedded across multiple organisational levels, influencing product development processes, cross-functional collaboration, and strategic planning (Erichsen & Christensen, 2013). This variation is particularly evident in OBM firms, where differences in internal capabilities, organisational culture, and collaboration practices result in uneven levels of design integration.

The Danish Design Ladder (DDL), developed by the Danish Design Centre, provides a widely recognised framework for conceptualising design maturity at the organisational level (Danish Design Centre, 2001). The model presents design adoption as a four-stage progression, as illustrated in the following framework:

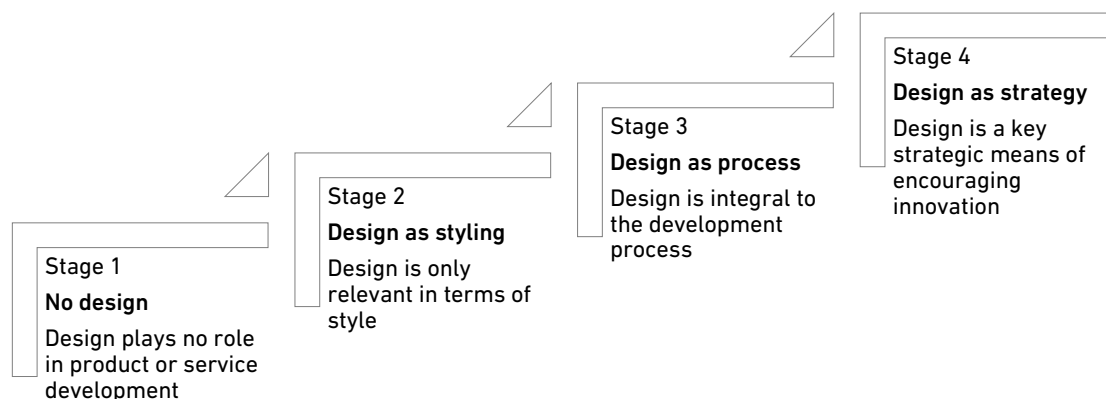


Figure 2. 3: The Danish Design Ladder (Adapted from Danish Design Centre, 2001)

The stages range from non-design, where design plays little or no role in product development, to design as styling, where it is applied primarily to aesthetic refinement, typically at later stages of development (Bruce & Morris, 1994; Borja de Mozota, 2003). At higher levels, design becomes embedded within the product development process, contributing to concept development, user experience, and cross-functional collaboration (Erichsen & Christensen, 2013), and ultimately evolves into a strategic capability that informs innovation and long-term organisational direction (Borja de Mozota, 2003).

Beyond its descriptive role, the DDL has been widely used as both a diagnostic and developmental framework in academic and industrial contexts. It enables organisations to assess their current level of design integration and identify pathways for capability development (Borja de Mozota, 2003). However, progression along the ladder is neither automatic nor strictly linear, but instead requires sustained organisational learning, managerial commitment, and the development of cross-functional capabilities. This limitation reflects the complexity of organisational contexts, where firms may exhibit characteristics across multiple stages simultaneously rather than following a strictly sequential progression. Existing studies suggest that many firms remain at lower levels of maturity, where design is applied in a limited or reactive manner, particularly in engineering-dominated environments (Bruce & Bessant, 2002).

The relevance of the DDL is particularly significant in the context of OBM firms transitioning from OEM or ODM models towards brand-led innovation. Empirical evidence indicates that in many such firms, design activities remain concentrated in later stages of product development, often limited to aesthetic refinement (Bruce & Morris, 1994). This suggests that differences in design maturity significantly shape both the role of design within organisations and the nature of collaboration with external design agencies. Accordingly, the DDL provides a useful theoretical lens for understanding how CDPs should be adapted to different organisational contexts.

This framework is therefore used in this study as an analytical basis for categorising OBM firms according to their level of design maturity, and for informing the development of the CDP model in subsequent chapters.

2.6 Design challenges in the transition to OBM

The transition from OEM or ODM to OBM represents a fundamental reconfiguration of how value is created and captured. This transformation requires firms to move beyond production efficiency toward innovation-driven, brand-oriented strategies in which design functions as a strategic capability that defines brand identity, user experience, and market differentiation (Li & Kozhikode, 2008; Wang & Wu, 2012). Yet, many East Asian firms, historically embedded within efficiency-centred production systems, have tended to undervalue design, perceiving it

as a decorative afterthought rather than as a catalyst for innovation. As Yan, Chiang, and Chien (2014) observe, their competitiveness has long been anchored in cost control and delivery performance, leaving limited institutional capacity to support design-led transformation. Overcoming this legacy necessitates both the systematic development of design capabilities and a cultural shift that embeds design within strategic decision-making, organisational learning, and long-term value creation.

2.6.1 Internal design capability barriers

A significant body of research identifies persistent structural barriers that hinder the integration of design within OBM organisations. Manzanoğlu and Er (2018) note that latecomer firms following the OEM–ODM–OBM upgrading trajectory often exhibit low levels of design management capability, resulting in the marginalisation of design as an operational rather than strategic function. Similarly, Chiva-Gómez et al. (2013) demonstrate that in small and medium-sized enterprises (SMEs) with limited design capability, design activities are frequently detached from strategic decision-making and innovation processes, thereby constraining their potential to contribute to sustained value creation.

Another critical limitation concerns knowledge absorption and the absence of internal infrastructure to support design capability. Acklin (2011) argues that organisations with little prior design experience encounter significant challenges in embedding design knowledge, recruiting skilled professionals, and establishing autonomous design teams. In the absence of institutionalised design functions, design tends to be confined to aesthetic refinement or product styling, with minimal influence on upstream conceptual development and strategic planning.

For OBM firms evolving from OEM origins, the central challenge extends beyond the acquisition of design resources. It involves constructing organisational systems, leadership frameworks, and cultural foundations that enable design to operate as an integrated strategic capability. Until these structural, cultural, and absorptive barriers are systematically addressed, design will remain peripheral rather than transformative within OBM development trajectories.

2.6.2 Limitations and misalignment in external collaboration

In response to internal capability constraints, many OBM firms collaborate with external design agencies to augment their design resources. While outsourcing can inject fresh perspectives and enhance product distinctiveness, it also presents considerable challenges. Bruce, Cooper, and Vázquez (1999) argue that effective design collaboration depends on strong internal leadership, a shared understanding of design processes, and strategic alignment; in their absence, partnerships often yield suboptimal design outcomes. Similarly, Berends, Reymen, Stultiëns, and Peutz (2011) demonstrate that weak internal systems and ambiguous expectations frequently result in coordination failures, inconsistent brand expression, and unsatisfactory market responses among small manufacturers working with external designers.

A recurring issue involves process incompatibility. External design agencies typically prioritise user research, conceptual exploration, and iterative prototyping, whereas OBM firms often concentrate on technical specifications, production feasibility, and cost optimisation. These divergent paradigms create communication gaps and procedural misalignment. As a result, design is frequently introduced only after technical parameters have been finalised, diminishing its capacity to contribute to early-stage innovation and user-centred development.

Empirical evidence from South Korean SMEs transitioning from OEM to OBM further illustrates these challenges. One firm, for instance, reported terminating collaboration with a design consultancy due to perceived inconsistencies between design outputs, manufacturing constraints, and brand identity. Design proposals were rejected during the production stage because they conflicted with existing manufacturing infrastructure. Such incidents reflect not merely aesthetic misjudgements but deeper structural deficiencies—namely, limited mutual understanding, misaligned implementation contexts, and inadequate strategic coherence.

Comparable challenges are observed elsewhere. Amsden and Chu (2003) note that in Taiwan's electronics industry, firms developed strong production capabilities yet remained deficient in branding, autonomous design capacity, and consumer engagement. This underscores that external collaboration alone does not guarantee successful OBM transformation; it must be accompanied by an organisational culture grounded in design-led thinking, absorptive capacity, and strategically aligned internal systems.

1) Gradual versus strategic integration of design

Scholars propose differing pathways for embedding design in OBM firms. One is an incremental approach following Borja de Mozota's (2003) design maturity model, in which firms evolve from using design for styling to function, process, and ultimately strategy. Alternatively, Junginger (2009) advocates for a top-down transformation, whereby organisations deliberately reframe their structures, decision-making systems, and mental models to integrate design across all dimensions rather than applying it incrementally. The suitability of each approach depends on a firm's maturity, resource base, and readiness for change. While gradual integration may suit firms with limited infrastructure, it risks reinforcing external dependency and hindering internal capability development.

2) Design capability as Organisational learning

Design capability should be understood not merely as technical or aesthetic competence but as a dynamic organisational capacity built on tacit knowledge, collaborative sense-making, and empathetic problem-solving (Brown & Wyatt, 2010). Building this capability requires more than hiring designers; it entails a cultural transformation that values experimentation, ambiguity, and user insight. When external agencies are engaged as co-creative partners rather than transactional vendors, repeated collaboration and mutual adaptation can facilitate the internalisation of design logic and the enhancement of absorptive capacity. However, success depends on structured partnership frameworks, shared language, and institutional mechanisms that enable reflection and learning. Without such foundations, outsourcing remains superficial and fails to produce long-term capability gains.

3) Towards design-integrated OBM strategy

Recent scholarship emphasises the necessity of embedding design across business functions for successful transformation in manufacturing-oriented firms. Clarkson and Eckert (2005) critique traditional design process models as overly abstract and insufficiently grounded in organisational realities, reinforcing the need for context-specific frameworks that reconcile engineering logic with creative exploration. The structural and cognitive challenges facing firms transitioning to OBM remain substantial. Although outsourcing can temporarily alleviate internal deficiencies, it does not guarantee sustainable innovation unless accompanied by

internal capability building and strategic alignment. As Appio et al. (2021) argue, aligning advanced capabilities such as design with organisational strategy, culture, and process is essential for achieving lasting value creation.

The shift to OBM therefore requires more than the tactical deployment of design; it demands the institutionalisation of design thinking, the creation of cross-functional infrastructures, and the cultivation of a culture that values creativity, user insight, and strategic coherence. Future research should focus on developing hybrid design process frameworks tailored to OBM contexts, models that balance external collaboration and internal learning to embed design as a strategic and adaptive capability.

2.7 External design agencies: strategic role and integration

In the evolving landscape of OBM, external design agencies have emerged as indispensable strategic partners that bridge internal capability gaps, stimulate innovation, and shape user-centred, market-driven product strategies. Historically, design outsourcing was viewed through the narrow lens of cost efficiency and resource supplementation. However, contemporary scholarship increasingly recognises that design agencies serve as strategic collaborators capable of co-creating value, facilitating organisational learning, and accelerating the institutionalisation of design maturity within client firms (Bruce & Docherty, 1993; Junginger & Sangiorgi, 2009).

1) Typologies of design engagement

Bruce and Docherty (1993) present one of the most influential frameworks for understanding the relationship between client firms and external design consultancies. Through a comparative study of UK manufacturers, they identify three primary modes of engagement: (1) transactional projects focused on short-term outcomes such as product styling or packaging; (2) functional partnerships characterised by recurring collaboration and co-development; and (3) strategic alliances built on mutual trust and long-term innovation alignment. This typology demonstrates that the value generated through design outsourcing depends on the depth of collaboration and the degree of integration into the client's organisational processes. For many OBM firms with limited internal design capability, collaboration often remains confined to transactional or

functional engagements, reinforcing a procurement-based mindset that limits innovation potential (Bruce & Docherty, 1993).

Building on this foundation, subsequent studies have extended the notion of design engagement toward design-intensive collaboration. Junginger and Sangiorgi (2009) argue that early and sustained involvement of design partners during the research, ideation, and prototyping stages enhances cross-functional coherence and facilitates knowledge transfer. They contend that design should be recognised not merely as a creative service but as an organisational capability integral to innovation, market positioning, and long-term competitiveness.

2) Strategic integration and implications for OBM firms

Despite these advantages, empirical evidence indicates that many OBM firms struggle to integrate design agencies effectively. Bruce and Morris (1994) found that misaligned expectations, weak communication systems, and the absence of shared process frameworks often lead to suboptimal outcomes. Similarly, Berends, Reymen, Stultiëns, and Peutz (2011) observed that small manufacturing firms frequently experience coordination breakdowns due to unclear governance and limited absorptive capacity for external design knowledge. Such misalignments result in delayed innovation cycles and failure to embed design learning within the firm.

For East Asian OBM firms, where design capability remains underdeveloped, external design agencies often provide essential access to global design knowledge and aesthetic expertise. However, excessive reliance on external partners without corresponding internal learning structures can lead to strategic dependency. Amsden and Chu (2003) demonstrated in their study of Taiwan's industrial upgrading that firms depending solely on subcontracted design and branding rarely achieve sustainable brand differentiation or innovation leadership. Effective OBM transformation, therefore, requires not only access to design expertise but also the capacity to absorb, adapt, and institutionalise design logic within organisational systems.

Within this context, design agencies function as knowledge intermediaries rather than mere service providers. Long-term, trust-based partnerships can act as vehicles for design transfer, enabling OBM firms to internalise methodologies, expand aesthetic competencies, and develop coherent brand identities. To maximise these benefits, firms must establish shared decision-

making mechanisms, engage agencies at early stages of development, and maintain transparent evaluation frameworks (Berends et al., 2011; Bruce & Morris, 1994).

3) Early vs. Late-stage involvement

A recurrent issue in the literature concerns the timing of agency involvement in the NPD process. Many OBM firms introduce design agencies only after key technical parameters and cost constraints have been established, limiting their contribution to surface-level refinements. This pattern exemplifies what Gemser and Leenders (2001) describe as treating design as an ornamental rather than strategic function, where aesthetic enhancement replaces conceptual innovation. Conversely, early-stage collaboration allows agencies to participate in research, problem framing, ideation, and iterative prototyping, enhancing differentiation, customer satisfaction, and brand coherence (Bianchi, Biemans, & Della Piana, 2016). Such early engagement embeds user-centred logics throughout the NPD cycle and fosters stronger integration between design and business strategy.

However, early collaboration requires enabling organisational conditions. Firms must cultivate trust, openness to experimentation, and structural mechanisms that facilitate co-creation. OBM firms with limited design literacy or hierarchical management often lack the absorptive capacity to internalise and act on insights derived from design partnerships, thereby restricting agencies to incremental improvement rather than transformative innovation.

4) Strategic design outsourcing: risks and enablers

When strategically managed, design outsourcing yields benefits that extend beyond immediate deliverables. Bianchi et al. (2016) demonstrate that firms engaging effectively with external partners experience knowledge spillovers, creative diversity, and accelerated access to emerging tools and methodologies. Such collaborations enhance dynamic capabilities by promoting mutual learning between internal and external teams. Yet these relationships also entail risks, such as erosion of design ownership, stagnation of internal capability, misalignment of organisational vision, and loss of control over intellectual property (Bianchi et al., 2016). These risks are most acute in OBM firms with immature design management systems and weak design leadership.

To mitigate these challenges, relational contracting and structured communication frameworks are critical. Junginger and Sangiorgi (2009) recommend establishing “design integrator” roles, internal mediators who bridge cognitive and procedural divides between agencies and in-house teams. These integrators facilitate cross-disciplinary dialogue and ensure that creative outcomes align with technical feasibility and strategic intent. The Danish Design Centre’s Design Ladder provides a diagnostic framework for assessing design maturity. Firms at Level 1 (“No Design”) typically struggle to benefit from agency partnerships, while those at Levels 2 or 3 (“Design as Styling” or “Design as Process”) demonstrate the structural and cultural readiness necessary for co-creative collaboration (Danish Design Centre, 2003).

5) Inter-organisational learning and capability transfer

Beyond immediate outputs, external collaborations can serve as mechanisms for organisational learning and capability transfer. Argyris and Schön (1978) conceptualise organisational learning as the embedding of new knowledge into collective routines and beliefs. Design partnerships expose firms to new ways of framing problems, embracing ambiguity, and synthesising user insights into actionable innovation. Design agencies frequently introduce structured tools such as user personas, journey mapping, co-creation workshops, and rapid prototyping that help firms transition toward iterative, user-centred modes of operation (Brown & Wyatt, 2010; Cross, 2006).

The success of such knowledge transfer depends on three key factors: the establishment of systematic knowledge exchange mechanisms (e.g., debriefing and documentation), a culture supportive of experimentation and reflection, and the internal capacity for critical evaluation and adaptation (Kolb, 1984; Schön, 1983). However, many OBM firms still treat collaborations as isolated transactions rather than components of a learning continuum, limiting cumulative capability development (Bruce & Morris, 1994). Firms that institutionalise learning from partnerships, by contrast, embed design practices into strategic processes and achieve higher levels of innovation and brand differentiation.

Bridging the methodological divide between agile, iterative design processes and linear, stage-gate engineering systems requires mutual adaptation. Agencies must accommodate clients’ operational constraints, while OBM firms must embrace iterative exploration and tolerate the ambiguity inherent in design-led innovation (Cooper, 2008; Cross, 2006). Ultimately, design

agencies act as catalysts for knowledge diffusion, cultural transformation, and strategic renewal. To sustain these benefits, OBM firms must reframe partnerships as co-evolutionary systems of learning, where design expertise contributes to long-term capability building and organisational maturity rather than short-term procurement efficiency.

2.8 NPD in OBM Firms: Structural constraints, design capability, and collaborative process

NPD forms the cornerstone of successful OBM strategy, serving as the principal mechanism through which firms integrate technological competence, market insight, and design capability to create differentiated value. Ulrich and Eppinger (2009) define product development as a dynamic system that unites technology, marketing, and design, positioning it at the core of competitive advantage. Unlike OEM or ODM enterprises that depend on external specifications, OBM firms must internally synthesise user insight, design thinking, and brand strategy to achieve autonomous innovation (Bruce & Cooper, 1997; Chiva & Alegre, 2009). Yet small and medium-sized OBM firms in East Asia continue to face structural barriers to institutionalising systematic NPD processes. Their production-oriented legacies and underdeveloped design infrastructures limit strategic integration, resulting in rigid hierarchies and fragmented innovation (Hobday, Boddington & Grantham, 2012).

Firms transitioning from OEM or ODM frequently inherit linear, engineering-led routines that prioritise technical precision, cost control, and compliance with client requirements. Yan, Chiang and Chien (2014) argue that these entrenched operational logics, shaped by decades of contract manufacturing, constrain adaptability and suppress creative exploration. The transformation toward OBM thus requires more than functional upgrading, it demands a paradigmatic shift from reactive production to proactive, design-integrated innovation. Hobday, Boddington and Grantham (2012) further note that this inertia is reinforced by the under-institutionalisation of design within both policy frameworks and firm-level structures, where efficiency and risk minimisation prevail over experimentation and creativity. Consequently, many OBM firms fail to develop sustained innovation trajectories or distinctive brand identities, despite their formal transition beyond OEM or ODM status.

A central structural issue in OBM NPD is the absence of formalised, organisation-wide design processes. Many SMEs operate without defined methodologies, process maps, or stage-gate checkpoints, resulting in ad hoc design execution and weak alignment with strategic goals. Bruce and Morris (1994) describe such firms as relying on “rather ad hoc” management systems that lack communication and accountability mechanisms. Likewise, Berends, Reymen, Stultiëns, and Peutz (2011) highlight how unclear briefs and late-stage designer involvement often result in cost overruns and reduced creativity.

Formalising design processes constitutes not only an administrative necessity but also a developmental strategy. Chiva-Gómez, Alegre, and Gutiérrez-Gracia (2013) define design management capability as a dynamic organisational capability, the ability to convert design knowledge into continuous innovation. This requires deliberate decision points, structured feedback loops, and interdisciplinary review mechanisms. From a process management perspective, Cooper (2008) demonstrates that structured frameworks such as the Stage-Gate® model enhance innovation performance through iterative learning and evidence-based decisions. Conversely, firms compressing timelines without such frameworks risk undermining validation and user focus. Gemser and Leenders (2001) likewise confirm that early and consistent design involvement throughout NPD significantly improves differentiation and market performance.

To address capability gaps, many OBM firms turn to external design agencies. While such collaborations offer access to advanced creative methodologies and user-centred insights, they also reveal managerial deficiencies. Bruce, Cooper, and Vazquez (1999) emphasise that leadership commitment, clear objectives, and shared procedural understanding are prerequisites for effective partnerships. Without them, design outputs often appear stylistically refined yet strategically misaligned. Berends et al. (2011) similarly note that communication breakdowns between firms and consultancies hinder both efficiency and learning. Acklin (2011) argues that institutionalising design knowledge management, via documentation, debriefing, and cross-departmental learning can transform episodic outsourcing into a cumulative learning process, ultimately strengthening internal creative autonomy and design maturity.

Beyond these structural and procedural concerns, cultural and cognitive barriers persist. In many OBM organisations dominated by engineering mindsets, design is still regarded as a cost centre rather than a strategic investment. Under short-term performance pressures, production

efficiency routinely takes precedence over innovation. Roper (2018) demonstrates that despite strong empirical evidence linking design investment to innovation and productivity, few SMEs allocate resources systematically to design. This managerial scepticism perpetuates design marginalisation and inhibits long-term capability development.

Cultural resistance further impedes design integration. Meng and Guo (2024) argue that SMEs seeking to institutionalise design must restructure collaboration and learning mechanisms to prioritise empathy, iteration, and experimentation over hierarchy and control. Le, Nguyen, and Doan (2024) show that manufacturing-oriented inertia continues to limit strategic adaptation and design-led innovation diffusion. Consequently, design remains confined to aesthetic refinement rather than influencing strategic conception or user experience.

These intertwined structural and cultural barriers sustain a transactional view of design. Branding, user research, and emotional design are often treated as secondary, resulting in products that are technically sound but emotionally undifferentiated. Centeno, Hart, and Dinnie (2013) contend that effective brand building depends on integrating product design, user experience, and symbolic meaning. Wong and Merrilees (2008) further demonstrate that SMEs with mature brand orientation achieve stronger customer loyalty and coherence. Similarly, Okeke, Eze, and Omodero (2023) show that structured user journey mapping enhances experience design and customer retention, yet such tools remain underused in firms lacking design process literacy.

The optimisation of NPD in OBM firms depends on aligning structure, culture, and capability around a unified design vision. Overcoming production-centred thinking and embedding design as a strategic, knowledge-generating function enables OBM firms to evolve from efficiency-driven operations to innovation-led enterprises, securing sustainable and distinctive competitiveness in the global market.

2.8.1 Opportunities for collaborative process and design integration

Despite these challenges, the literature offers several strategies for NPD processes and improving design integration in OBM firms. These include:

- 1) Adopting structured design templates: Implementing standardised design briefs, milestone schedules, and validation criteria can improve clarity and communication between internal and external teams (Pugh, 1991).
- 2) Creating integrated product teams (IPTs): Embedding external designers into cross-functional teams promotes real-time decision-making and knowledge transfer (Ulrich & Eppinger, 2000).
- 3) Modifying stage-gate systems: Including parallel design sprints within existing development frameworks allows for flexibility without sacrificing control (Cooper, 2001).
- 4) Using Co-design for capability development: Joint projects can act as learning platforms, allowing internal teams to adopt agency methodologies and gradually build design literacy (Bruce & Docherty, 1993).
- 5) Strategic scoping of agency roles: Clearly defining whether external designers are contributing tactically, functionally, or strategically ensures role clarity and maximises return on collaboration (Bruce & Morris, 1994).

These interventions do not require firms to transform into fully design-led organisations overnight. Rather, they represent scalable, pragmatic pathways through which OBM enterprises can gradually evolve their design capability while leveraging external expertise.

The challenges associated with NPD and design capability development in OBM firms are not limited to technical deficiencies or project-level inefficiencies. Rather, they stem from entrenched structural paradigms, cultural inertia, and strategic blind spots. The combined effects of weak internal capability, misaligned external collaboration, and superficial branding practices result in fragmented, short-lived design initiatives with limited long-term impact.

For OBM firms to realise the full potential of design-led innovation, a dual transformation is required: the systematic development of internal design processes and infrastructure, and the intelligent, structured engagement of external design partners. This must be supported by leadership commitment, cultural openness, and the strategic re-framing of design as a driver of competitive advantage and organisational learning.

2.8.2 Design as a strategic innovation capability in OBM firms

Although design process theory has evolved over more than six decades, there remains a lack of empirically grounded frameworks that adequately explain and support the realities of OBM firms. The literature demonstrates a progression from early rationalist and engineering-based models (Archer, 1963; Ulrich & Eppinger, 1995) to reflective, participatory, and iterative paradigms (Lawson, 1990; Buchanan, 1992; Cross, 2000). Yet, despite their conceptual maturity, these theories remain largely abstract and discipline-specific, failing to accommodate the organisational complexity, market dynamics, and strategic demands of firms transitioning from OEM or ODM to OBM. None of the existing models provide an empirically validated, context-sensitive framework that integrates strategic design thinking, interdepartmental coordination, and external collaboration suitable for OBM contexts.

The limitations of conventional models are particularly evident in late-industrialising economies in East Asia. OBM firms in these regions typically operate within hierarchical, production-oriented structures dominated by cost-driven decision-making. Such conditions inhibit the adoption of design-led innovation frameworks, as traditional linear models (Pahl & Beitz, 1996; Wallace & Clarkson, 1999) fail to reflect the iterative, collaborative, and multi-stakeholder realities of modern OBM practice. Similarly, iterative models such as the Double Diamond (Design Council, 2006), while conceptually clear, lack prescriptive mechanisms for cross-functional integration among design, engineering, and marketing in resource-constrained environments. These contextual limitations highlight the need for a more adaptive and modular design process model that accommodates the diverse operational and cultural conditions of OBM firms.

Moreover, although the importance of design in OBM development is increasingly acknowledged, its strategic and organisational roles remain under-theorised. Prior studies (Walsh et al., 1992; Tsai & Hung, 2010; Zhang & Zhang, 2012) identify persistent barriers including the marginalisation of design departments, weak alignment between design and corporate strategy, and the isolation of design within engineering-dominated organisations. Despite such insights, design continues to be regarded primarily as an aesthetic supplement rather than a processual and integrative mechanism that enables organisational learning, innovation, and differentiation.

A particularly critical research gap concerns the collaborative interface between OBM firms and external design agencies. While existing studies (Bruce & Docherty, 1993; Berends et al., 2011; Erichsen & Christensen, 2013) recognise the creative benefits of external partnerships, they provide limited explanation of how knowledge generated through such collaborations is transferred, absorbed, and institutionalised within OBM organisations. Empirical evidence suggests that these collaborations are often project-based and outcome-driven, yielding short-term design outputs but limited long-term capability development. Consequently, OBM firms tend to rely repeatedly on external expertise rather than cultivating internal design capacity. The absence of structured mechanisms for knowledge transfer, absorptive learning, and mutual process alignment remains a fundamental weakness in the current understanding of OBM–agency collaboration. Addressing this limitation requires investigating how collaborative models can evolve from transactional exchanges into systems of joint learning and sustainable innovation.

Furthermore, the review reveals a lack of flexible design process models calibrated to different levels of design maturity among OBM firms. Existing literature assumes a uniform level of design capability, applying generic models that overlook differences in organisational readiness, resource capacity, and experiential learning. Yet OBM firms vary widely in design literacy and strategic integration. For firms at early stages, highly structured frameworks such as the Design Research Methodology (Blessing & Chakrabarti, 2009) or the Double Diamond are difficult to apply effectively. Conversely, more advanced OBM firms require dynamic frameworks that support iterative refinement and cross-functional co-creation. The absence of maturity-based adaptability within existing process models limits their practical applicability across industrial contexts.

Collectively, these findings reveal two interrelated research gaps. First, there is insufficient theoretical and empirical understanding of collaboration structures and knowledge transfer mechanisms between OBM firms and external design agencies, particularly regarding how such partnerships can foster sustainable capability development and design integration. Second, there is a lack of flexible, context-sensitive design process models that adapt to varying levels of design maturity within OBM firms, supporting scalable adoption of design-led innovation.

Addressing these gaps requires the development of a hybrid, adaptive design process model that combines theoretical rigour with practical relevance. Such a model must reflect both the organisational realities of late-industrialising OBM firms and the dynamic nature of external design collaboration. By doing so, design can be redefined not merely as a project-based activity but as a strategic infrastructure for continuous learning and sustainable innovation in the OBM context.

2.9 Research gap

Although design process theory has developed over more than six decades, there remains a lack of an empirically grounded framework that can adequately explain and support the realities of OBM firms. The literature demonstrates a progression from early rationalist and engineering-based models (Archer, 1965; Ulrich & Eppinger, 1995) to reflective, participatory, and iterative paradigms (Lawson, 1990; Buchanan, 1992; Cross, 2000). Yet, despite their conceptual maturity, these theories remain largely abstract and discipline-specific, failing to accommodate the organisational complexity, market dynamics, and strategic demands of firms transitioning from OEM or ODM to OBM. None of the existing models offer an empirically validated, context-sensitive framework that integrates strategic design thinking, interdepartmental coordination, and external collaboration in ways suitable for OBM environments.

The limitations of conventional models become particularly evident in the context of late-industrialising economies such as those in East Asia. OBM firms in these regions typically operate within hierarchical, production-oriented structures dominated by cost-driven decision-making. Such conditions inhibit the adoption of design-led innovation frameworks, as traditional linear models (Pahl & Beitz, 1996; Wallace & Clarkson, 1999) struggle to reflect the iterative, collaborative, and multi-stakeholder realities of modern OBM practice. Similarly, iterative models such as the Double Diamond (Design Council, 2006), while conceptually clear, lack prescriptive mechanisms for integration across design, engineering, and marketing in resource-constrained settings. These contextual limitations underscore the need for a more adaptive and modular design process model that reflects the diverse operational and cultural conditions of OBM firms.

Moreover, the literature indicates that although the importance of design within OBM development is increasingly acknowledged, its strategic and organisational functions remain under-theorised. Previous studies (Walsh et al., 1992; Tsai & Hung, 2010; Zhang & Zhang, 2012) have identified persistent challenges such as the marginalisation of design departments, the weak alignment between design and corporate strategy, and the isolation of design within engineering-led organisations. Despite these observations, design continues to be regarded primarily as a supplementary or aesthetic component rather than as a processual and integrative mechanism that facilitates organisational learning, innovation, and differentiation.

A particularly critical research gap emerges in the collaborative interface between OBM firms and external design agencies. While existing studies (Bruce & Docherty, 1993; Berends et al., 2011; Erichsen & Christensen, 2013) acknowledge the creative benefits of external partnerships, they provide limited insight into how knowledge generated through such collaborations is transferred, absorbed, and institutionalised within OBM organisations. Empirical evidence indicates that these collaborations are often project-based and outcome-driven, leading to short-term design outputs but little long-term capability building. As a result, OBM firms tend to rely repeatedly on external expertise rather than developing internal design capacity. The absence of structured mechanisms for knowledge transfer, absorptive learning, and mutual process alignment represents a fundamental weakness in the current understanding of OBM–agency collaboration. Addressing this limitation requires exploring how collaborative models can evolve from transactional relationships into systems of joint learning and sustainable innovation.

In addition, the review reveals the absence of flexible design process models calibrated to varying levels of design maturity among OBM firms. The existing literature assumes a uniform level of design capability, applying generic models that fail to account for differences in organisational readiness, resource capacity, and experiential learning. However, OBM firms display considerable heterogeneity in their internal design literacy and strategic integration of design. For firms at early stages of design adoption, highly structured and resource-intensive frameworks such as DRM (Blessing & Chakrabarti, 2009) or Double Diamond are difficult to implement effectively. Conversely, more advanced OBM firms require dynamic frameworks that enable iterative refinement and cross-functional co-creation. The lack of design maturity-based adaptability within current process models thus limits their applicability and scalability across diverse industrial contexts.

Taken together, the literature highlights two interrelated research gaps that this study seeks to address.

First, there is a lack of theoretical and empirical understanding of the collaboration structure and knowledge transfer mechanisms between OBM firms and external design agencies, particularly concerning how such partnerships can lead to sustainable capability development and design integration.

Second, there is a lack of flexible, context-sensitive design processes that can adapt to varying levels of design maturity within OBM firms, enabling scalable adoption of design-led innovation.

Addressing these gaps requires the development of a hybrid and adaptive design process model that integrates theoretical rigour with practical applicability. Such a model must accommodate both the organisational realities of late-industrialising OBM firms and the dynamic nature of external design collaboration. By doing so, design can be repositioned not merely as a project-based function but as a strategic infrastructure for continuous learning and sustainable innovation within the OBM context.

2.10 Chapter summary

This chapter traced the evolution of design process theories and examined their relevance to the operational and strategic realities of OBM firms. It outlined the progression from early rationalist and engineering-based models (Archer, 1963; Ulrich & Eppinger, 1995) to reflective and human-centred paradigms (Lawson, 1990; Buchanan, 1992; Cross, 2000), highlighting the field's shift from linear problem-solving to iterative and strategically embedded innovation processes.

Despite these advancements, a persistent gap remains between theory and industrial practice. Traditional stage-based models are ill-suited to the complex, multi-stakeholder environments of OBM firms, while iterative frameworks such as the Double Diamond (Design Council, 2006) offer limited guidance for implementation in resource-constrained or hierarchical settings.

These limitations expose the inadequacy of universal models in capturing the organisational and cultural diversity of late-industrialising economies.

The strategic role of design within OBM firms also remains insufficiently theorised. Although design is recognised as a source of competitiveness, it often remains confined to aesthetic or supportive functions. Production-oriented management cultures and weak cross-functional integration continue to restrict the adoption of design-led innovation practices, particularly in East Asian contexts.

Another recurring issue concerns collaboration between OBM firms and external design agencies (Bruce & Docherty, 1993; Berends et al., 2011; Erichsen & Christensen, 2013). While these partnerships generate creative value, they rarely result in lasting capability development due to the absence of structured mechanisms for knowledge transfer and organisational learning.

Furthermore, existing design process models fail to accommodate varying levels of design maturity. Most assume uniform capability, overlooking differences in design literacy, resources, and strategic integration. Firms at early adoption stages need structured, accessible processes, whereas more advanced firms require adaptive, iterative frameworks.

To conclude, two key research gaps emerge: first, a lack of understanding of how OBM firms and design agencies collaborate and exchange knowledge for sustainable capability development; and second, the absence of flexible, context-sensitive design process models aligned with differing levels of design maturity. Addressing these gaps requires a hybrid, adaptive design process framework that combines theoretical rigour with practical applicability. Such a model should enable OBM firms to institutionalise design as a strategic infrastructure for innovation and learning while strengthening internal capabilities through sustained, knowledge-based collaboration with external partners.

Chapter 3. Research methodology

3.1 Introduction

This chapter defines the methodological approach adopted to examine how design processes are strategically embedded and operationally managed within OBM firms and design agencies. It outlines the philosophical foundation, research design, data collection methods, and analytical procedures employed to address the study's objectives. Grounded in an interpretivist qualitative paradigm, the study conceptualises design as a context-dependent cognitive and organisational practice. To capture this complexity, it adopts a multi-method qualitative approach, combining literature review, case studies, in-depth interviews, participatory observation, and qualitative evaluation.

The research is structured around a three-stage process consisting of Foundation, Development, and Refinement. The Foundation stage establishes the conceptual grounding through literature review and exploratory fieldwork. The Development stage focuses on systematic data collection and thematic analysis, leading to the construction and initial validation of a preliminary design process model. The Refinement stage incorporates evaluative feedback to propose an improved framework for design process integration within OBM organisations. This staged approach ensures a coherent progression from theoretical grounding to empirical investigation and subsequent refinement.

A multiple-case study design is adopted as the primary research strategy due to the complexity of design integration within OBM firms. Yin (2018) and Eisenhardt (1989) support the use of case study research for examining contemporary organisational phenomena in context, particularly where multiple sources of evidence are required. In this study, their methodological insights justify the adoption of a multiple-case design for exploring design integration. The transition from OEM and ODM to OBM involves organisational, cultural, and managerial transformations that cannot be adequately examined through purely quantitative approaches. The case study method therefore enables in-depth investigation of how design operates within real organisational settings, capturing interactions between design, engineering, and management practices.

The inclusion of multiple cases enables both within-case analysis and cross-case comparison, allowing the identification of recurring patterns alongside contextual variation. Rather than pursuing statistical generalisation, the study adopts an analytical generalisation approach, where theoretical insights are developed and refined through empirical observation.

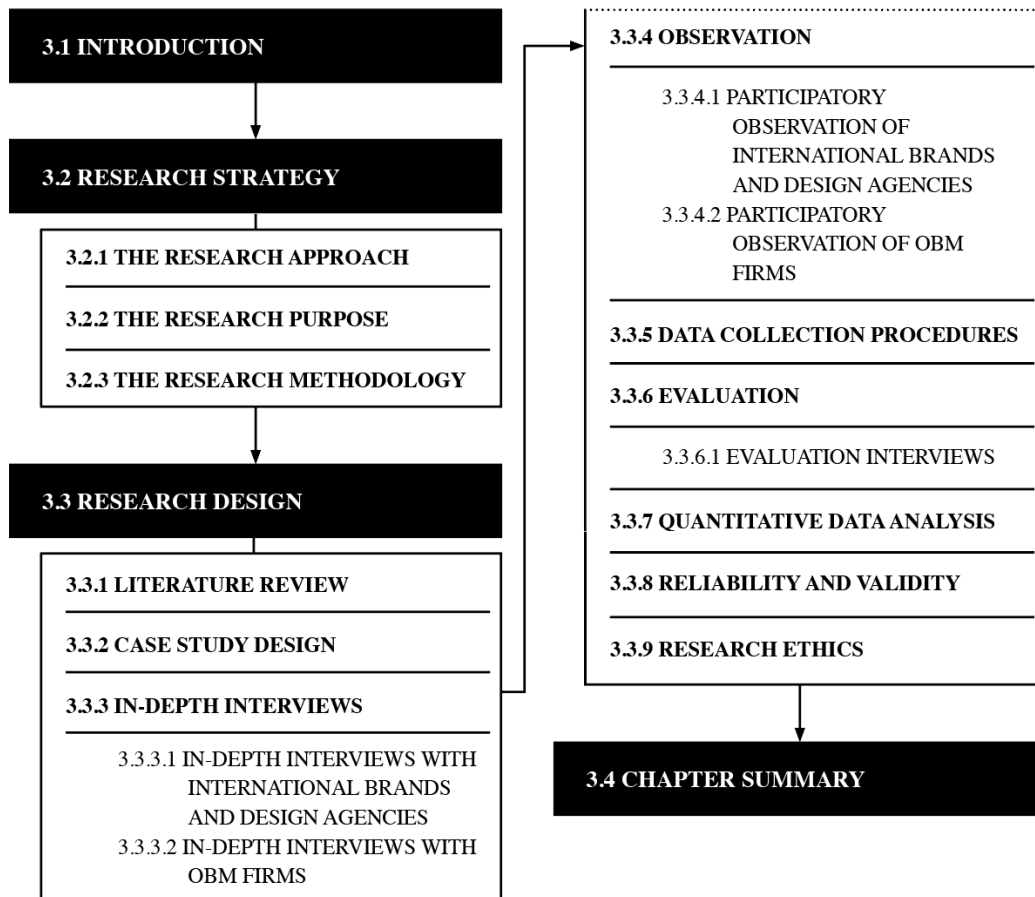
Data analysis combines thematic analysis with cross-case synthesis. The analytical process is informed by Miles, Huberman, and Saldaña (2014), particularly in relation to qualitative coding, data organisation, and memoing. Thematic analysis supports the identification of key patterns, while cross-case comparison enhances analytical depth and consistency. Methodological rigour is strengthened through triangulation across multiple data sources, supported by reflexive memoing and peer review.

Reflexivity is further informed by Finlay (2002), emphasising the importance of critically examining the researcher's role in shaping interpretation. In this study, reflexivity functions as an integral component of the analytical process, supporting a more contextually grounded understanding of design processes.

Ethical procedures were conducted in accordance with Brunel University London's research ethics requirements, including prior ethics approval, voluntary participation, anonymisation, and secure data handling.

This chapter establishes a coherent methodological framework by integrating a multiple-case study design with rigorous qualitative analysis. This approach provides a robust foundation for examining design as a strategic and operational practice within OBM firms, enabling the development of contextually grounded and theoretically informed insights into design process integration.

Figure 3.1 Overview of the overall structure and procedural flow of this chapter.



[Figure 3. 1: Chapter map]

3.2 Research strategy

A research strategy refers to a structured plan that defines how research questions are addressed and how research objectives are achieved through coherent procedures and logic (Saunders, Lewis, & Thornhill, 2007). It provides a systematic framework that aligns philosophical foundations, theoretical perspectives, methodology, and methods of data collection and analysis (Patton, 1990).

This study aims to explore how OBM firms optimise their design processes to transform design capability into organisational innovation performance. This phenomenon unfolds within complex organisational settings involving strategic decision-making, corporate structures, and interactions between designers and management. To address this complexity, the study adopts a qualitative multiple case study strategy, which enables an in-depth and context-sensitive investigation.

The research is grounded in a constructivist epistemology within an interpretivist paradigm. Constructivism views knowledge as co-constructed through interactions between the researcher and participants rather than as an objective reality (Guba & Lincoln, 1994). Accordingly, the researcher plays an active role in meaning-making, and knowledge is understood as contextually situated and interpretive (Merriam & Tisdell, 2015).

The adoption of a case study strategy is methodologically appropriate for examining complex organisational phenomena embedded in real-life contexts. The transition from OEM/ODM to OBM involves organisational learning, capability development, and evolving managerial practices, which cannot be adequately explained through linear or variable-based approaches. Case study research enables a holistic examination of how design functions and evolves within specific organisational settings. As noted by Yin (2018), case studies are particularly suited to investigating contemporary phenomena where the boundaries between phenomenon and context are not clearly defined. Stake (1995) further emphasises the interpretive nature of case study research in capturing the uniqueness of each case.

Following Yin (2018), case study research is particularly appropriate when the research seeks to address how questions, involves limited control over behavioural events, and focuses on contemporary organisational contexts. These conditions align with the objectives of this study, which aims to understand how design operates as a strategic resource within OBM firms.

The use of a multiple case study design enables both within-case analysis and cross-case comparison, supporting the identification of recurring patterns alongside contextual differences. Rather than aiming for statistical generalisation, the study adopts an analytical generalisation approach, where theoretical insights are developed through empirical observation.

Case study research also allows the integration of multiple qualitative data sources. This study draws on semi-structured interviews, internal documents, project materials, and participatory observation. The use of diverse data sources supports triangulation, enhancing the credibility and dependability of the findings (Merriam, 1998; Creswell & Poth, 2018).

The research design follows three key principles derived from Yin (2018). First, case selection is based on criteria that ensure relevance and variation: firms that have transitioned to OBM or

integrated design into internal product development, firms where design is linked to business strategy, and firms representing diverse industries and product categories. Second, data collection is conducted through multiple qualitative sources. A prior literature review establishes the conceptual framework, followed by semi-structured interviews with key stakeholders, supported by documentary analysis and field observation. These sources are triangulated to strengthen interpretive reliability. Third, data analysis combines inductive thematic analysis with cross-case comparison. Thematic analysis identifies key factors within each case, while cross-case analysis reveals common patterns and differentiating strategies across cases.

By adopting a qualitative multiple case study strategy grounded in constructivist epistemology, this study examines design processes within OBM firms as context-dependent organisational practices. This approach enables a theoretically informed and empirically grounded understanding of how design contributes to organisational innovation and capability development.

3.2.1 The research approach

Research typically proceeds along one of three logical pathways, deductive, inductive, or abductive, and the choice depends on the research purpose and the complexity of the phenomenon under investigation (Gray, 2014; Hyde, 2000; Dubois & Gadde, 2002). The deductive approach begins with existing theories or hypotheses and tests them, a theory-testing route that is commonly applied in quantitative research (Creswell, 2014). In contrast, the inductive approach derives theory from specific observations and cases, representing a theory-generating inquiry that is effective for identifying the contextual characteristics and patterns of real-world phenomena (Bryman, 2016; Gray, 2014).

This study primarily adopts an inductive approach, complemented by elements of abductive reasoning. Induction, as a bottom-up logic, develops concepts and theoretical insights from qualitative empirical observation, which is particularly well suited to understanding how the design processes of OBM firms are strategically integrated within organisational contexts (Blaikie, 2007). Because design is not a fixed or objectively measurable entity but a dynamic and socially constructed process, the study also incorporates abductive reasoning, through

which qualitative data, collected via case studies, in-depth interviews, and participatory observation, are iteratively compared and interpreted against existing theoretical frameworks (Dubois & Gadde, 2002).

This abductive complement creates a continuous and reflective interaction between qualitative evidence and theoretical interpretation. Analysis begins with insights drawn from individual cases and evolves through systematic comparison with established theoretical constructs such as design processes and theories of strategic design management. Through this iterative process, the research transcends simple empirical description and moves towards the construction of mid-range theory, capable of explaining how design activities contribute to organisational transformation and innovation capability building.

The adoption of mid-range theory is particularly appropriate to the aims and methodological structure of this study. As Merton (1968) notes, mid-range theory bridges the gap between empirical observation and grand theory, offering a level of abstraction that explains mechanisms operating within specific contexts. This enables the research to interpret how design is integrated into OBM firms without excessive generalisation or theoretical discontinuity, while maintaining strong explanatory grounding in qualitative evidence. Furthermore, consistent with the systematic combining approach proposed by Dubois and Gadde (2002), abductive reasoning enables a non-linear cycle in which data collection, analysis, and theoretical framing proceed iteratively. Mid-range theory thereby provides a conceptual anchor that consolidates emergent findings and integrates them into a coherent theoretical framework.

Eisenhardt (1989) similarly argues that theory building through case study research can generate novel and empirically grounded theoretical propositions, while Edmondson and McManus (2007) emphasise that inductive and abductive qualitative approaches are particularly suited to domains that remain theoretically nascent. Since the integration of design within OBM firms is still underexplored, the methodological combination of induction and abduction adopted here demonstrates strong theoretical and methodological fit.

This study establishes a qualitative, mid-range theory-oriented research design by integrating inductive empiricism with abductive interpretation. This approach enables both the deep understanding of design as a lived organisational phenomenon and the reconfiguration of

theoretical perspectives surrounding design process integration. Through this design, the study constructs an explanatory framework that reveals how design activities in OBM firms function as strategic resources that strengthen innovation capability and organisational learning.

3.2.2 The research purpose

Research can generally be classified into three categories according to its purpose: exploratory, descriptive, and explanatory (Gray, 2014; Neuman, 2014; Robson, 1993). Exploratory research answers “what” questions and is particularly useful when existing knowledge about a phenomenon is limited (Gray, 2014; Saunders, Lewis & Thornhill, 2007). Such research seeks to generate new insights and establish the direction and conceptual framework of subsequent studies, employing methods such as literature reviews, expert interviews, and focus group discussions (Hunter, McCallum & Howes, 2018; Ayton, Tsindos & Berkovic, 2023).

Descriptive research, on the other hand, aims to systematically portray the relationships among different situations, individuals, or events to explain the structural characteristics of a phenomenon (Gray, 2014) and provide an integrated overview (Hedrick, Bickman & Rog, 1993). It mainly answers “how” and “who” questions (Neuman, 2014) and, in qualitative studies, is used to depict complex social or organisational contexts in concrete detail. Explanatory research focuses on identifying the causes of social behaviours or phenomena (Neuman, 2014; Yin, 2009) and revolves around “why” and “how” questions. It deepens understanding by interpreting relationships derived from exploratory or descriptive studies or by analysing causal mechanisms among variables (Gray, 2014). These three research types are not mutually exclusive but rather form a continuous process of development, exploratory, descriptive, and then explanatory (Gray, 2014; Hunter et al., 2018).

This study combines exploratory and explanatory purposes (Gray, 2014; Robson, 2011; Neuman, 2014). From an exploratory perspective, it investigates how design functions and is integrated as a strategic organisational resource in the transition from OEM and ODM structures to the OBM model, an area insufficiently addressed in previous research. The focus is on revealing the role of design not merely as a phase of product development but as a strategic catalyst influencing innovation, learning, and decision-making structures within organisations.

From an explanatory perspective, the study analyses the mechanisms through which CDP contributes to organisational innovation and the enhancement of design capability. In other words, it seeks to interpretively explain the structural effects of design integration on product development, managerial decision-making, and the formation of creative organisational capabilities. Through this, the study elucidates how design activities operate within the structures of strategic resource allocation, collaboration, and decision-making to generate innovation outcomes (Robson, 2011).

To achieve these objectives, the study adopts a qualitative multiple case study strategy based on Yin's (2018) principles of multiple case study design, alongside Eisenhardt's (1989) approach to theory building from cases. First, the case selection criteria include: (i) firms that have experienced the transition to OBM or have utilised design processes within internal product development; (ii) firms where design is directly linked to business strategy; and (iii) firms representing diversity across industries and product categories. Second, the data collection employs multiple sources of evidence. A literature review was conducted to establish the conceptual framework and theoretical foundation, synthesising existing research on design processes in OBM firms, design integration within organisations, and design capability maturity. Empirical evidence was then gathered through semi-structured interviews, documentary analysis of internal reports and project materials, and field observations. These diverse data sources were triangulated to enhance reliability and interpretive validity. Third, data analysis combined inductive thematic analysis and cross-case comparison. Thematic analysis was used to identify key factors in design process within each case, while cross-case comparison enabled the identification of common patterns and distinctive strategies.

Accordingly, the dual research purpose of this study can be summarised in three aspects. First, to explore how the design process in OBM firms affects organisational innovation and design capability; second, to explain the contextual and organisational structures that shape this relationship; and third, to propose and construct a CDP suitable for the context of OBM firms, based on the empirical findings.

Such purpose setting aims to achieve both theoretical completeness and practical contribution. Eisenhardt (1989) argues that the primary contribution of case study research lies in theory building, where the essence of the method is not merely to interpret phenomena but to derive new conceptual frameworks or models. Similarly, Yin (2018) emphasises that case study

research is an empirical methodology that addresses “how” and “why” questions, enabling theory development grounded in deep contextual understanding. Therefore, this study goes beyond identification and interpretation of phenomena, using patterns derived from cross-case comparison and inductive analysis to propose a CDP tailored to the practical conditions of OBM firms, thereby contributing to both academic theory development and industrial application.

3.2.3 Research Methodology

A research methodology constitutes the fundamental structure that ensures the consistency and validity of a study, determining the framework through which the researcher investigates and interprets phenomena (Creswell & Poth, 2018). When a methodological framework is not clearly established, the research risks losing coherence and logical integrity.

Within design research, methodology extends beyond a set of procedures for data collection; it represents a theoretical and practical framework that guides the process of design itself. In this study, the research methodology was developed by first referencing the Double Diamond model (Discover–Define–Develop–Deliver) as a representative procedural framework, followed by comparative analysis with alternative theories and frameworks. This iterative examination enabled the selection and modification of a process structure most suitable for the study’s purpose and context.

1) The Double Diamond as a representative procedural model

The Double Diamond model, proposed by the UK Design Council (2006), is one of the most widely recognised frameworks in design research and practice. It visualises the design process as four sequential stages, Discover, Define, Develop, and Deliver, structured around the cyclical alternation of divergent and convergent thinking. These stages represent the logical progression from problem identification to problem redefinition, idea development, and implementation.

Each phase of the model encompasses distinct yet interconnected research and creative activities. For instance, during the Discover stage, designers undertake literature reviews, market analyses, user studies, field observations, and interviews to explore the problem space.

In the Define stage, insights are synthesised and requirements clarified to establish key design objectives. The Develop stage focuses on ideation, concept sketching, prototyping, and iterative user testing, while the Deliver stage involves pilot implementation, refinement, and the formulation of strategies for diffusion and scaling. This structured process provides a coherent alignment between research design, data collection, and project execution.

2) Critical positioning and methodological adaptation

However, the absence of a clearly defined methodology can lead to inconsistencies in the research's direction, coherence, and analytical validity. To mitigate this, the present study employs the Double Diamond model not merely as a procedural template but as a heuristic and interpretive framework, a conceptual reference through which empirical findings can be structured and understood. At the same time, the study critically compares this model with other established design frameworks to evaluate their heuristic power, applicability, and contextual adaptability.

This approach acknowledges that no single design process model offers a universal or prescriptive solution; rather, models should be viewed as contextually responsive constructs that can be reconfigured according to the specific organisational and cultural environment of each project. This methodological stance aligns with existing scholarly discourse, which argues that design frameworks must remain flexible and open to recontextualisation in practice (Dorst, 2011; Kimbell, 2011; Kochanowska & Rochacka, 2021).

Accordingly, the methodology adopted in this study treats the Double Diamond as both a guiding framework and a subject of critical examination, adapting its procedural logic to the realities observed within the case studies. Through this interpretive and adaptive approach, the research secures methodological coherence while ensuring that theoretical rigour is balanced with contextual relevance and empirical depth.

3) Comparison with alternative design frameworks

To ensure methodological rigour and contextual suitability, this study critically compared the Double Diamond model with three other influential design frameworks, Design Thinking, Design Research Methodology (DRM), and Framing / Frame Creation. Each offers valuable

perspectives on design processes but differs in philosophical orientation, methodological structure, and applicability to interpretivist, qualitative case research.

a) Design Thinking

Design Thinking is a practice-oriented approach that promotes creative problem solving within organisations, structured around iterative cycles of empathy, define, ideate, prototype, and test (Brown, 2008). It emphasises experiential engagement and collaborative experimentation to foster innovation.

However, while effective for driving organisational creativity, Design Thinking tends to prioritise action and iteration over analytical rigour, making it less suited to the systematic data structuring and interpretive depth required in qualitative case research (Kimbell, 2011; Johansson-Sköldberg, Woodilla, & Çetinkaya, 2013). Its focus on facilitating innovation through rapid experimentation offers limited theoretical generalisability, as it lacks a consistent analytical framework for cross-case comparison or theory construction.

In this respect, Design Thinking aligns more closely with practice-based innovation than with interpretive inquiry, which seeks to understand underlying meanings, structures, and contextual interrelations within design processes.

b) Design Research Methodology (DRM)

The Design Research Methodology (DRM), developed by Blessing and Chakrabarti (2009), provides a systematic and engineering-oriented framework that progresses through four phases: Research Clarification → Descriptive Study I → Prescriptive Study → Descriptive Study II. This method is particularly effective in studies focused on product development tools, technical optimisation, or quantitative performance validation.

Nevertheless, DRM assumes a positivist epistemology, emphasising measurability, reproducibility, and researcher intervention. Such assumptions contrast with the interpretivist orientation of this study, which seeks to explore human experience, organisational culture, and perceptual change through qualitative interpretation rather than controlled measurement (Blessing & Chakrabarti, 2009; Creswell & Poth, 2018).

While DRM contributes a valuable level of procedural rigour, its structured, hypothesis-driven design does not align with the contextual, emergent, and meaning-centred nature of organisational design integration. For this reason, it was deemed methodologically incompatible with the objectives of this research.

c) Framing and Frame Creation

Dorst (2011) reconceptualises design not as a linear sequence of phases but as an iterative process of meaning construction and redefinition. He argues that design emerges through frame creation, wherein problem and solution spaces co-evolve through cycles of reframing rather than being treated as separate stages.

This perspective highlights the interpretive and hermeneutic nature of design, aligning conceptually with the exploratory and reflexive orientation of this study. Within this framework, the Double Diamond model can be reinterpreted as a series of hermeneutic loops, where each phase enables the generation, testing, and transformation of new frames of understanding.

The frame creation perspective thus extends the Double Diamond beyond its procedural representation, embedding it within a more conceptually dynamic and meaning-oriented process. This provides an important theoretical bridge between design process models and interpretive research traditions, reinforcing the study's aim to contextualise design as an evolving organisational discourse rather than a fixed methodological sequence.

Table 3. 1: Summary comparison of key design research frameworks

Framework	Core characteristics	Research orientation	Strengths	Limitations	Relevance to this study
Design Thinking (Brown, 2008; Kimbell, 2011; Johansson-Sköldberg et al., 2013)	Iterative process of <i>empathise – define – ideate – prototype – test</i> ; promotes creative and collaborative problem-solving	Practice-driven, innovation-oriented	Encourages creativity, user-centred perspective, and rapid ideation	Lacks analytical rigour and theoretical generalisability; weak structure for systematic data analysis	Useful for stimulating creativity but insufficient for interpretive, case-based theoretical inquiry
Design Research Methodology (DRM) (Blessing & Chakrabarti, 2009)	Structured engineering-based method (<i>Research Clarification → Descriptive Study I → Prescriptive Study → Descriptive Study II</i>)	Positivist, hypothesis-driven	Provides procedural clarity and replicable structure for empirical design research	Emphasises measurement and control; unsuitable for interpretivist, context-dependent analysis	Too positivist for this study's qualitative, socially constructed perspective

Framing / Frame Creation (Dorst, 2011)	Design as iterative reframing and meaning construction; problem–solution co-evolution	Interpretivist, hermeneutic, meaning-oriented	Supports reflective reasoning, contextual understanding, and theoretical depth	Offers limited procedural guidance; relies on interpretive skill of researcher	Conceptually compatible; complements Double Diamond with a dynamic, meaning-centred dimension
Double Diamond (Design Council, 2006)	Four-stage divergent–convergent process (<i>Discover – Define – Develop – Deliver</i>)	Pragmatic, adaptable	Clear visualisation; widely recognised model linking research and design stages	Adopted as the reference framework and subsequently adapted into a customised six-stage process	Adopted as the reference framework and subsequently adapted into a customised six-stage process

The comparative analysis demonstrates that while Design Thinking and DRM offer strengths in practical innovation and procedural control, they lack the interpretive flexibility and contextual sensitivity required for this research. Conversely, Dorst’s frame creation approach offers a conceptual foundation that supports the adaptive and hermeneutic interpretation of the Double Diamond, making it the most compatible with this study’s qualitative, interpretivist framework.

4) Limitations and constraints of the Double Diamond model

Previous studies have acknowledged that the Double Diamond model provides a clear and accessible visual language for education, communication, and design management training. However, when applied within real organisational and industrial contexts, several limitations and constraints have been identified.

- 1) Implied linearity and lack of iteration: The four-stage schematic representation tends to underplay the non-linear and cyclical nature of actual design practice. In reality, design processes frequently involve iteration, backtracking, and reframing between stages, which the model only partially captures (Ramsden, 2023).
- 2) Abstractness and limited procedural guidance: While conceptually elegant, the model remains at a high level of abstraction, offering insufficient operational guidance for decision-making criteria, stakeholder alignment, or project management in complex environments (Kochanowska & Rochacka, 2021).
- 3) Limited reflection of contextual and organisational constraints: Although the Double Diamond provides a valuable communicative framework, it insufficiently addresses the influence of contextual factors such as time pressure, resource limitation, organisational culture, and structural constraints that frequently shape design implementation in practice. Empirical analyses of design management processes indicate that such

constraints critically affect decision-making and team coordination, yet they are largely absent from the model's conceptual scope (Kochanowska & Rochacka, 2021; Smart Interface Design Patterns, 2023; Ramsden, 2023).

- 4) Weakness in addressing wicked problems: In highly complex or uncertain design contexts, problem definitions and solutions evolve through abductive reasoning and frame shifts. However, the static, stage-based nature of the Double Diamond does not fully accommodate such dynamic processes of sensemaking and reframing (Dorst, 2011).

Synthesising the above critiques and comparative analyses, this study establishes a customised three-stage procedural model, Foundation, Development, and Refinement, which integrates the strengths of existing design research methodologies while aligning with the interpretive and qualitative nature of multiple-case study research. The proposed framework retains the conceptual clarity of the Double Diamond model but redefines its logical progression, iterative feedback loops, and validation mechanisms to better reflect the cyclical and contextual dynamics of qualitative inquiry.

The three macro stages encompass six interdependent phases: Awareness – Discover – Develop – Validation – Refining – Deliver. These phases operate as continuous and mutually reinforcing cycles rather than fixed linear steps, allowing the research process to evolve in response to emerging insights, contextual variations, and empirical feedback. Through this reconfiguration, the framework maintains the communicative simplicity of the Double Diamond while overcoming its inherent linearity and abstraction, establishing a more situated, reflexive, and methodologically coherent structure for investigating design integration within organisational contexts.

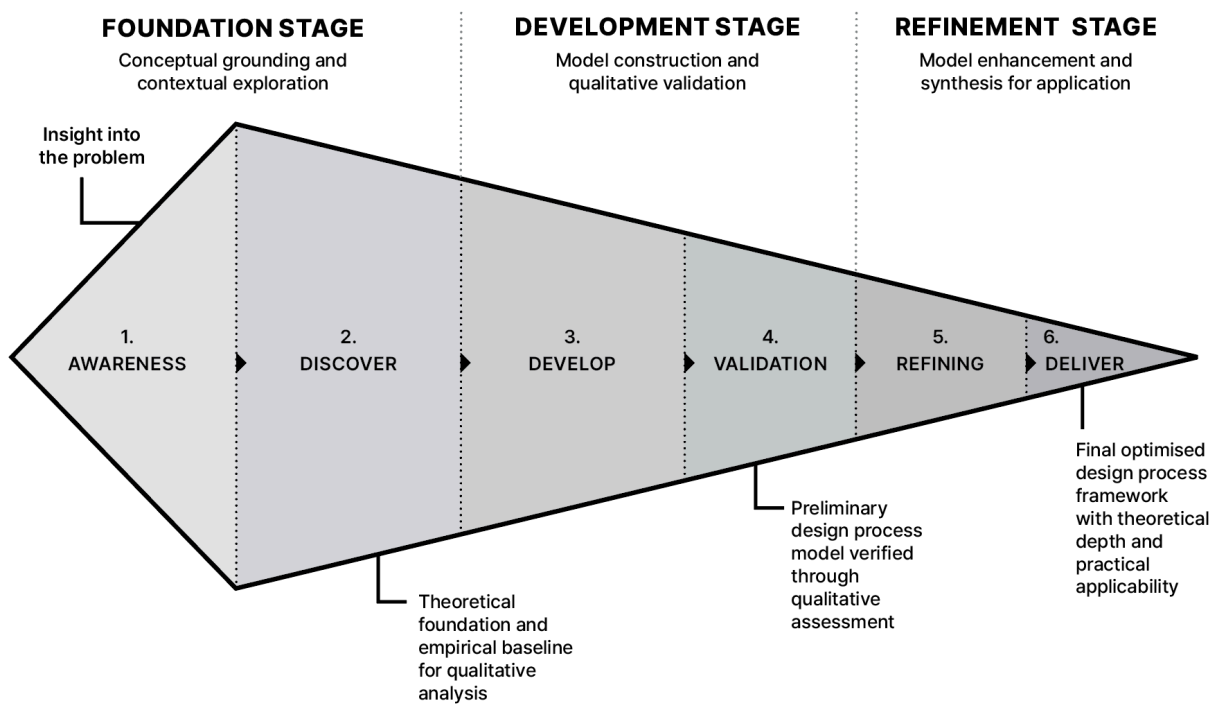


Figure 3. 2: Visualisations of the customised research process model

The adoption of this context-based customised process is grounded in both theoretical and methodological justification. As Suchman (2007) asserts, human action unfolds through situated interaction rather than adherence to predetermined plans. From this perspective, research design must function as a flexible and adaptive framework that evolves through the researcher's engagement with participants and the research environment. This view aligns with the principles of qualitative inquiry, where understanding emerges through interaction, reflection, and contextual adaptation rather than mechanical procedure.

Within the Research through Design (RTD) paradigm, Zimmerman, Forlizzi, and Evenson (2007) highlight that design knowledge emerges through iterative cycles of making, reflection, and evaluation. In this view, adapting the research process to the context of inquiry constitutes not a methodological compromise but a core act of knowledge construction. Such iterative tailoring enhances both the rigour and the contribution of design research by grounding findings in authentic practice.

The Design Council (2019) likewise reconceptualised the Double Diamond as a principle-based and open framework that enables flexible sequencing, repetition, and contextual adaptation. This aligns with Holtzblatt and Beyer's (2014) *Contextual Design*, which

emphasises tailoring design activities to organisational and user constraints to strengthen ecological validity and practical relevance.

Accordingly, the customised three-stage framework developed in this study; Foundation, Development, and Refinement, reflects the interpretive logic of qualitative case research while addressing the contextual complexity of real-world organisational environments. The Foundation stage establishes theoretical grounding and contextual awareness through literature review and exploratory fieldwork. The Development stage formulates and validates a preliminary design process through qualitative analysis, iterative synthesis, and expert dialogue. The Refinement stage incorporates feedback and empirical insights to yield a contextually adaptive and theoretically grounded framework.

Rather than prescribing a rigid sequence, this three-stage process supports flexible boundaries, iterative loops, and adaptive decision points according to each organisation's characteristics, design maturity, and industrial conditions. This adaptive structure strengthens theoretical coherence and practical applicability, enhancing the methodological integrity, reliability, and transferability of the research findings.

5) Customised three-stage research process: Building a design process through foundation, development, and refinement

This process is a customised research framework designed to explore how design is strategically integrated and implemented within organisations. Each stage follows the logical flow of qualitative inquiry, progressing from the establishment of theoretical foundations to empirical exploration and process construction, and finally to verification and proposition.

I. Foundation stage (Awareness & Discover)

This stage establishes the conceptual basis and problem awareness of the research. In the Awareness stage, an extensive literature review and background analysis are conducted to identify trends and limitations in previous studies related to design–organisation relationships, OBM transition, and design processes. Through this, the analytical framework and key research questions are developed, ensuring the theoretical validity of the study. The Discover stage focuses on empirical exploration to understand the field context. In-depth interviews are conducted with representatives from international brands, design agencies, and OBM firms,

while participatory observation is carried out with selected companies to analyse actual design practices and decision-making processes. This exploratory research provides the foundational data for subsequent coding and interpretation.

II. Development stage (Develop & Validation)

This stage focuses on analysing the collected data to develop and validate the initial design process. In the Develop stage, qualitative coding, pattern identification, and categorisation of interview and observation data are performed to examine how design operates under structural and cultural constraints within organisations. Based on this analysis, a preliminary design process is developed. In the Validation stage, the process' credibility and applicability are examined through closed qualitative interviews with experts and OBM practitioners. This process evaluates how accurately the process reflects industrial and organisational realities, collecting feedback from participants. The validation procedure is conducted as a dialogic process grounded in practical resonance rather than the researcher's interpretation alone, thereby strengthening reliability and interpretive consistency.

III. Refinement stage (Refining & Deliver)

In this stage, feedback obtained from validation is incorporated to complete and propose a CDP. During the Refining stage, diverse expert and practitioner insights are analysed to reorganise the process' structure, sequence, and contextual alignment. Through this iterative refinement, the logical coherence and practical applicability of the process are enhanced. Finally, in the Deliver stage, the completed design process is visualised and articulated, clarifying its theoretical and practical significance. The proposed process framework explains the strategic value and operational mechanisms of design integration within organisations, deriving concrete implications for design management, product development, innovation policy, and industrial application.

This customised process comprises three integrated stages, Foundation, Development, and Refinement, retaining the clarity of the Double Diamond model while achieving greater depth and practical validity through iterative verification and contextual adaptability. By establishing the research basis in the Awareness and Discover stages, constructing and validating an empirical process in the Develop and Validation stages, and finalising and proposing the collaborative process in the Refining and Deliver stages, this framework presents a

comprehensive research structure for understanding design as a core strategic process within organisational transformation.

3.3 Research design

Research design is a comprehensive plan that provides a specific direction for the procedures undertaken within the research model (Creswell, 2014; Gray, 2014). In general, a research design encompasses the purpose of the study, the type of questions to be addressed, the techniques employed for data collection, the sampling methods, and the approaches used for data analysis (Gray, 2014). Creswell (2014) defines research design as “a structure of decisions and procedures ranging from philosophical assumptions to data collection and analysis,” emphasising that an effective design should align not only with the research problem and methodology but also with the theoretical and practical contexts in which the study is situated. Likewise, Gray (2014) describes research design as “an integrated plan that organises the flow from qualitative and quantitative tools through to data collection, analysis, and reporting,” stressing that, at the design stage, the research questions, methodological choices, data handling, and ethical considerations must be coherently integrated.

This study adopts a qualitative research design, constructed to investigate how OBM firms integrate and optimise design processes as strategic resources within organisational contexts. The qualitative design framework allows for an in-depth exploration of participants’ experiences, contextual factors, and organisational mechanisms. It relies exclusively on case study, in-depth interview, participatory observation, and documentary analysis methods, without any quantitative survey, experiment, or statistical measurement. The design was structured to ensure methodological coherence and analytical depth through iterative interpretation, triangulation, and reflexivity.

The research design is composed of three interrelated stages: Foundation, Development, and Refinement, each forming a coherent progression from conceptual exploration to empirical interpretation and practical synthesis. Figure 3.3 presents an overview of the overall qualitative design framework of this study.

I. Foundation stage (Awareness & Discover)

The first stage, the Foundation stage, aimed to establish the conceptual basis of the research and define the research problem, thereby setting the overall direction of the study. During the Awareness phase, an extensive literature review was conducted to examine how international companies and latecomer OBM firms have adopted design as a strategic resource, and to analyse the industrial and organisational contexts surrounding the OBM transition. Previous academic studies on design process models were critically reviewed to identify their theoretical limitations and the gaps between conceptual models and practical implementation in industrial environments.

In this process, international companies were selected on the basis that they had initially operated as OEM/ODM suppliers but later evolved into independent brand owners that internalised design as a core business capability. Conversely, OBM firms were selected primarily from South Korea, as South Korea represents a context that vividly illustrates the evolutionary pathway from OEM to OBM. East Asian firms commonly undergo functional upgrading driven by shared structural pressures, such as diminishing OEM profitability and the increasing demand for innovation-led competitiveness (Hobday, 1995; Kim, 1997; Lee & Lim, 2001; Manzanoğlu & Er, 2018). South Korea, having experienced this transition earlier, provides a rich empirical setting for investigating the mechanisms through which design becomes embedded as an organisational capability (Kim, 1997; Lee et al., 2015).

II. Development stage (Develop & Validation)

The second stage, the Development stage, consisted of two interlinked phases: Discovery and Development. The objective of this stage was to construct and verify a strategic framework for optimising the design processes of OBM firms based on insights derived from qualitative evidence.

In the Discovery phase, semi-structured in-depth interviews were conducted with representatives from international brands, design agencies, and OBM firms. The purpose was to understand how design was applied within NPD processes, and to identify the factors that either enabled or constrained the adoption of design-oriented practices. The study utilised case studies, qualitative interviews, and participatory field observations to gather rich empirical data concerning design activities, process structures, and decision-making dynamics.

Through the literature review and interviews with three international brand representatives, four design agency experts, and ten OBM company participants, a total of seventeen qualitative design process cases were identified. These cases enabled an in-depth understanding of the role of design in product development, the sequential and structural characteristics of design processes, the integration points with engineering and marketing, and the organisational challenges encountered during implementation.

In the Development phase, preliminary design processes were derived through inductive thematic analysis of the qualitative data. The processes were then refined through closed qualitative validation interviews with two design experts and two engineers from OBM firms. These discussions evaluated the clarity, procedural alignment, practical feasibility, and collaborative potential of each proposed process. The finalised processes from this stage resulted from iterative interpretation combining thematic analysis and reflective evaluation of the interview insights.

III. Refinement stage (Refining & Deliver)

The third stage, the Refinement stage, aimed to enhance the validity and practical usability of the proposed design process framework. Feedback from the validation phase was integrated to refine the structural logic and improve the comprehensibility of the processes. Through iterative review, comparison, and synthesis, the final CDP was developed. This final stage positioned the design process as an actionable framework that enables OBM firms to utilise design as a strategic and operational decision-making tool within their product development and innovation practices.

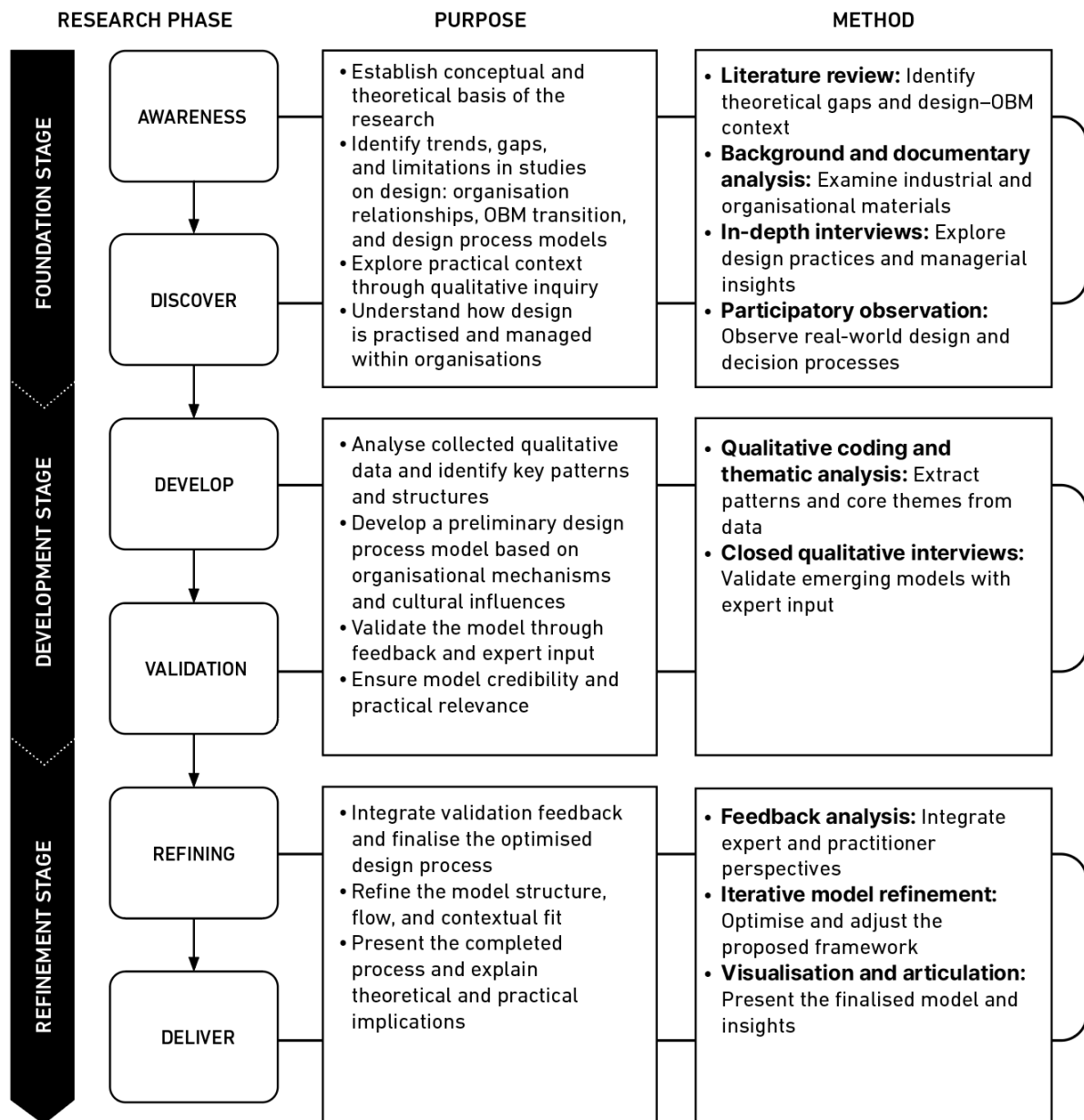


Figure 3. 3: Methodological framework

3.3.1 Literature review

A literature review is a scholarly process of systematically exploring and critically analysing existing knowledge relevant to a research topic, thereby establishing the intellectual foundation of the study (Hart, 2018; Neuman, 2014; Snyder, 2019). It aims to review and integrate prior studies objectively and rigorously, identifying, evaluating, and synthesising existing evidence with minimal bias. Hart (2018) defines a literature review as “an intellectual act that reveals the researcher’s capacity for critical thinking and meaning construction,” while Neuman (2014)

describes it as “a scholarly procedure for organising and reinterpreting accumulated knowledge about social reality.”

Rather than a simple summary, a literature review critically examines the strengths and limitations of previous research, identifies theoretical trends and gaps, and suggests new directions for inquiry (Snyder, 2019). Moreover, Gray (2014) emphasises that a literature review should not be regarded as a one-off exercise conducted solely at the outset of a project but as a continuous and iterative process throughout the research. This is because new questions and concepts may emerge as the research progresses, requiring the researcher to revisit and reinterpret existing literature.

Researchers gather information from diverse sources such as books, periodicals, academic journals, theses, government reports, policy papers, conference proceedings, and even media broadcasts (Gray, 2014; Neuman, 2014). However, not all sources possess equal scholarly credibility. Therefore, researchers must carefully assess each document’s relevance, balance of perspectives, and intended purpose and audience (Neuman, 2014). Through this evaluative process, the literature review transcends mere data accumulation and becomes a product of selective, critical interpretation aligned with the research objective.

The primary purposes of a literature review are to position the research within an existing academic context, identify key concepts, theories, methodologies, and gaps related to the topic, and strengthen the validity of the research design (Gray, 2014; Knopf, 2006; Neuman, 2014).

First, it helps the researcher to understand the intellectual tradition to which their topic belongs and the principal arguments presented in prior studies. Second, it identifies inconsistencies or deficiencies among previous findings, thereby justifying the need for new research. Third, by analysing the methodological strengths and weaknesses of earlier studies, it enhances the appropriateness and credibility of the current research design.

Thus, a literature review not only organises existing knowledge but also provides the conceptual foundation for constructing new insights and frameworks. It is, therefore, a process of intellectual inquiry through which the researcher clarifies how their study addresses gaps in prior research and contributes new perspectives to the field (Hart, 2018; Snyder, 2019).

Different types of literature review, in Table 3.2, exist depending on the purpose and nature of the research question. The major types include contextual review, historical review, integrative review, methodological review, self-study review, and systematic review (Grant & Booth, 2009; Torraco, 2005; Snyder, 2019).

Table 3. 2: Overview and suitability of literature review types for this study

Type of Review	Purpose and Key Features	Suitability for This Study
Context review	- Establishes academic, industrial, and policy context - Defines research environment	High: Provides essential contextual grounding within design and innovation discourse but lacks theoretical integration for explaining collaborative design process.
Historical review	- Examines chronological development of key concepts and theories	Mid-low: Helps trace the evolution of OBM and design management but less relevant to analysing current integration mechanisms.
Integrative review	- Synthesises theoretical, empirical, and methodological perspectives to propose new frameworks	Very high: Most appropriate; enables theoretical and empirical integration across design, management, and innovation fields to build a comprehensive conceptual model.
Methodological review	- Compares and evaluates research methods and analytical approaches	High: Supports justification of the qualitative multiple case study and DBR approaches, but functions as a supplementary rather than primary review.
Self-study review	- Reflects on researcher's own practice and positionality	Low: Not applicable; study focuses on organisational phenomena, not personal reflection.
Systematic review	- Collects and synthesises evidence through formal, replicable procedures	High: Ensures rigour and transparency, but overly procedural for the study's interpretive and exploratory focus.

Among these, the present study adopts an integrative literature review approach. An integrative review synthesises diverse theoretical and empirical perspectives to construct new conceptual models and theoretical understandings (Whittemore & Knafl, 2005; Torraco, 2005). This study combines insights from design management, organisational innovation, and strategic management to investigate how design process contributes to organisational innovation in OBM firms. This approach aligns with Snyder's (2019) assertion that integrative reviews generate "new theoretical insights through critical synthesis."

In addition, the study follows Gray's (2014) principle of a "continuous and iterative literature review process," whereby prior research is re-examined throughout the study to refine the conceptual framework. This iterative engagement with the literature provides a theoretical foundation for understanding how design processes operate as strategic resources within OBM organisations.

The literature review in this study serves three interrelated functions.

- First, as a theoretical foundation, it synthesises previous research on the strategic value of design processes and their organisational integration mechanisms during the OBM transformation stage.
- Second, as a conceptual framework, it compares and analyses existing models of design integration and organisational learning theory to establish analytical criteria for the case studies.
- Third, as a means of identifying research gaps, it critiques the tendency of prior studies to treat design as an isolated function and highlights the need to explore how design operates as a strategic process that drives organisational innovation and learning.

Thus, the literature review in this study functions not merely as a background summary but as a systematic integration of theoretical and methodological foundations, establishing a coherent basis for subsequent analysis and discussion. As Torraco (2005) notes, the integrative literature review is “a scholarly act of restructuring existing knowledge and generating new understanding,” a principle embodied in the present research.

In essence, a literature review is the process by which a researcher engages with accumulated academic knowledge to justify new avenues of inquiry. As Hart (2018) observes, it is not a mere listing of previous works but a reconstructive act that redefines the boundaries of knowledge through critical interpretation. By adopting the integrative review approach, this study synthesises multiple disciplinary perspectives, design management, organisational studies, and innovation research, to establish a theoretical foundation capable of explaining how design functions as a strategic mechanism that enhances organisational innovation and performance within OBM firms.

3.3.2 Case study design

This case study design was developed based on the research strategy, approach, and purpose outlined in the preceding sections, with the aim of examining in depth how the design processes of OBM firms are transformed into organisational innovation performance within their real-world contexts. The study integrates Yin’s (2018) principles of multiple case study design,

Stake's (1995) interpretive approach, and Eisenhardt's (1989) procedures for theory building from cases. Rather than seeking statistical generalisation, this design focuses on deriving theoretical insights by comparing and contrasting the contextual characteristics and embedded patterns across individual cases (Gerring, 2006; Merriam & Tisdell, 2015).

The adoption of a case study design in this research is not merely a methodological preference but a necessity dictated by the nature of the phenomenon under investigation. The transformation of OBM firms' design processes into organisational innovation represents a context-bound, multi-dimensional process involving cultural, managerial, and institutional dynamics that cannot be isolated or experimentally manipulated. As Yin (2018) and Stake (1995) emphasise, case study inquiry is uniquely suited to capture such complex and evolving dynamics within real-life organisational settings. Hence, the use of multiple embedded cases is essential to reveal the interrelationships between design integration, strategic decision-making, and innovation performance, enabling an interpretive understanding of how design becomes institutionalised as an organisational capability.

To begin with, the units of analysis and the boundaries of the cases were clearly defined. The primary unit of analysis concerns the design process operating within the product development systems of OBM firms, while the secondary unit involves the collaborative interactions among design, engineering, marketing, and management functions (Yin, 2018). The temporal scope of the analysis encompasses the major product development cycles that have taken place during the past five to eight years following the firms' transition towards OBM. The spatial scope primarily covers the industrial environment of South Korea.

A total of seventeen professionals specialising in design and social enterprise were interviewed as part of this study. These included three respondents from East Asian international brand firms, four representatives from design agencies in the United Kingdom and China, and ten respondents from OBM-related firms and organisations in South Korea and China. Through purposive sampling, the study was able to access the most relevant perspectives on design-oriented enterprises, OBM firms, and international brand corporations.

In the case of international brand firms and OBM enterprises, the selection of cases focused primarily on East Asia, particularly South Korea. This focus was not intended to emphasise any national specificity, but rather to ensure the analytical validity of South Korea as a

representative case group that exemplifies the universal patterns of OBM transition. Previous studies on East Asian latecomer firms have repeatedly identified a common trajectory from OEM to ODM, and subsequently to OBM. Such functional upgrading has been shown to follow remarkably similar patterns across national contexts, irrespective of differences in industrial structures or policy environments (Hobday, 1995; Er & Manzakoğlu, 2018; Lee, Song, & Kwak, 2015). These shared trajectories can be explained by the structural pressures faced by firms in the region, namely, the limitations of low-wage competition, the declining profitability of OEM models, and increasing policy imperatives for innovation-driven growth. Accordingly, the transition towards OBM should be understood not as a phenomenon driven by a single nation's industrial policy, but as a shared mechanism of corporate adaptation and growth within global value chains (Gereffi, 2005; Lee, Song, & Kwak, 2015).

Within this broader context, South Korea is regarded as one of the most advanced and systematically experienced case groups in terms of OBM transition among East Asian economies. Since the mid-1980s, Korean manufacturing firms have simultaneously faced rapid wage growth and endogenous technological accumulation, which prompted recognition of the structural limitations of the OEM model. Consequently, these firms began internalising design and branding capabilities to move towards higher value-added industries (Kim, 2006; Lee, Bae, & Choi, 2015). Although this developmental trajectory is structurally similar to those of Taiwan and China, the Korean case is distinctive in its early transition and the institutional embedding of design capabilities within corporate systems.

Furthermore, Er and Manzakoğlu (2018) highlight design management capability as a key mediating variable in firms' transitions to OBM within global value chains, arguing that this process depends more on the degree of internal integration of firm-level capabilities than on national industrial policy. This perspective aligns with the historical development of Korean firms, which began integrating design into organisational structures and processes as early as the mid-1990s. Therefore, analysing Korean cases provides both theoretical and empirical validity for identifying design internalisation as a central mechanism in OBM transition. Consequently, the selection of Korean OBM firms as the primary cases in this study is grounded not in national particularity but in their representativeness as an exemplary research set that most clearly demonstrates the universal mechanisms underlying OBM transition (Lee, Bae, & Choi, 2015; Lee, Song, & Kwak, 2015; Er & Manzakoğlu, 2018).

In contrast, the selection of design agencies was based on their collaboration experience with international brand corporations and OBM firms in East Asia. In particular, design agencies that had participated in joint projects recognised through international design awards were selected, ensuring that the study included organisations with formally acknowledged design excellence. This criterion was not intended to privilege reputation per se, but to enable the analysis of how external design expertise is integrated and utilised within OBM transition processes.

Subsequent case selection followed the principles of theoretical sampling as proposed by Eisenhardt (1989) and Yin (2014). The selection criteria were as follows: (i) firms that had experienced a transition from OEM or ODM to OBM, (ii) firms in which design was directly linked to corporate strategy and significantly influenced decision-making and resource allocation, and (iii) firms that ensured diversity across industries and product categories. Based on these criteria, the study selected nine OBM firms as primary cases, three global brands as comparative cases, and three design agencies as supplementary analytical cases. This multi-layered case composition enables what Yin (2018) refers to as the “logic of theoretical replication,” allowing the study to verify both recurring patterns and divergent strategic approaches across cases.

3.3.3 In-depth Interviews

This study aimed to establish a systematic understanding of design processes and activities across different industrial domains and to develop an approach for strengthening the utilisation of design within each organisation. To achieve this, it was essential first to understand how design processes operate in practice, including the perspectives and experiences of key stakeholders. Given the broad and complex nature of the research field, an in-depth exploration of the contextual meanings surrounding design practices was required. In this process, the interview was regarded as a powerful and effective tool for transforming participants’ tacit knowledge into explicit understanding of the studied phenomenon (Arksey & Knight, 1999).

Interviews are designed to explore and interpret the lived experiences of individuals and the meanings they ascribe to those experiences (Seidman, 2013). They represent one of the most fundamental qualitative data collection techniques (Kvale, 1996; Patton, 2015), enabling

researchers to capture rich and nuanced insights into human behaviour and organisational practice. Through sustained interaction between the researcher and the participant, interviews allow for the construction of a multilayered understanding of social and organisational phenomena (Creswell & Poth, 2018; Silverman, 2013). Merriam (1998) defines the interview as “the core tool of qualitative inquiry that allows researchers to understand the world from the participant’s point of view,” while Yin (2018) highlights that, within case study research, interviews are a key mechanism for describing context-rich realities and identifying complex causal relationships.

Within case study methodology, in-depth interviews extend beyond the mere collection of opinions. They are used to uncover the internal logic, relational structures, and interpretive dimensions of each case (Patton, 2002; Yin, 2018). The narrative data obtained through interviews are triangulated with other qualitative sources, such as documentary evidence and field observations, to enhance the study’s validity and reliability (Denzin & Lincoln, 2018).

The interview method performs several important functions. It enables researchers to explore participants’ knowledge, values, preferences, and attitudes in depth (Cohen, Manion, & Morrison, 2000; Gorden, 1975), while also ensuring that participants’ perspectives are captured authentically and independently (Bailey, 1987). By facilitating comparability across cases, well-structured interviews strengthen the credibility of the findings (Barriball & While 1994; Bailey, 1987). Gray (2014) categorises interview approaches into six types: structured, semi-structured, non-directive, focused, informal conversational, and problem-centred (Table 3.3).

Table 3. 3: Six interview approaches

Interview approach	Summary of description
Structured	Structured interviews are primarily used for quantitative data collection and involve prepared, standardised questions. Interaction between interviewer and respondent is minimal, and the format closely resembles a questionnaire administered verbally.
Semi-structured	Semi-structured interviews are commonly used in qualitative research. Although guided by a list of topics or questions, the interviewer may alter their order or wording and introduce new questions as themes emerge during the discussion.
Non-directive	Non-directive interviews are exploratory and aim to investigate topics in depth without predetermined questions. While the interviewer must understand the study’s purpose, their role is mainly to facilitate conversation and clarify responses for accurate interpretation.

Focused	Focused interviews are based on participants' reactions to specific, known situations. The interviewer, already familiar with the context, steers the conversation back to the topic if necessary, enabling a more targeted exploration of subjective perspectives.
Informal conversational	Informal conversational interviews develop spontaneously, with questions emerging naturally during interaction. This method offers flexibility but also carries a higher risk of interviewer influence on the direction of the conversation.
Problem-centred	Problem-centred interviews combine open, exploratory questioning at the beginning with a more structured follow-up phase. This format is particularly suited to biographical or experience-based studies, allowing participants to discuss personal perspectives related to the research problem.

Source: Adapted from Gray (2014)

Grounded in these theoretical discussions, this study adopted the semi-structured interview as the principal qualitative procedure. The semi-structured format involves preparing a set of key questions in advance while maintaining flexibility to adapt their order or content according to participants' responses (Bryman, 2016; Creswell & Poth, 2018). This approach allows the interviewer to preserve consistency in inquiry while enabling the discovery of unanticipated insights and emergent variables. It also facilitates the contextual interpretation of how design processes function and evolve across different organisations.

Following these methodological principles, this study conducted in-depth interviews with seventeen professionals specialising in design and social enterprise. The sample included three respondents from East Asian international brand firms, four representatives from design agencies in the United Kingdom and China, and ten respondents from OBM-related firms and organisations in South Korea and China. This composition allowed for the integration of multiple perspectives across design-led enterprises, OBM firms, and international brand corporations, providing a comparative lens on how design is embedded within organisational structures and strategies.

This research employed a qualitative approach based on non-probability sampling, with purposive sampling as the primary strategy. Purposive sampling involves the deliberate selection of participants based on the researcher's informed judgement about who can best contribute to the research objectives (Patton, 2002; Teddlie & Yu, 2007). Although other non-probability techniques such as snowball sampling or convenience sampling were considered, purposive sampling was deemed most appropriate given the study's objectives and the specialised nature of its participants.

The rationale for this choice lies in the researcher's professional affiliation with a design consultancy, which provided direct access to individuals possessing specialised experience and expertise relevant to the study, namely, design agencies and OBM firms. This insider position enabled the identification of a small yet highly specialised group of experts whose insights were particularly valuable for understanding how design is integrated into organisational and industrial contexts. Consequently, the selected sample ensured both the qualitative richness and comparative utility required for rigorous and meaningful qualitative inquiry.

Table 3.4 summarises the key characteristics of the respondents, including their organisational affiliations, roles, interview formats, and duration. It also outlines how the purposive sampling technique was applied in this study to identify and select participants with the most relevant experience and expertise.

Table 3. 4: In-depth interview participants

Interviewee group	Country	No. of participants	Title / Position	Organisation type	Expertise area	Sampling method
International brands	South Korea & Japan	3	Design directors / Senior design managers	Multinational brand firms	Design integration and product innovation in global brand context	Purposive sampling
Design agencies	United Kingdom & China	4	Creative directors / Design consultants	Independent and multinational design consultancies	Design strategy, collaboration with OBM firms, and design-led innovation	Purposive sampling
OBM firms	South Korea & China	10	Design directors / R&D managers / Executives	OBM manufacturing firms and support organisations	Product development process, design capability integration, and organisational innovation	Purposive sampling

3.3.3.1 In-Depth Interviews with international brands and design agencies

The in-depth interviews conducted with international brands and design agencies in this study aimed to explore participants lived experiences and perceptions in depth, focusing on how design processes operate within NPD and how they are interrelated with organisational and strategic decision-making. In-depth interviewing is a key method in qualitative research, designed to gain a rich understanding of participants' subjective meanings, attitudes, and experiences (Kvale, 1996; Seidman, 2013; Patton, 2015). Unlike standardised questionnaires,

in-depth interviews enable researchers to interpret phenomena contextually through direct interaction with participants, making them an essential tool within qualitative case study research (Yin, 2018; Merriam & Tisdell, 2015).

This study employed a semi-structured interview format, which balances the systematic structure of a guided interview with the flexibility of an open-ended conversation (Bryman, 2016; Creswell & Poth, 2018). Semi-structured interviews allow the researcher to maintain a consistent set of thematic questions while adapting the order and phrasing depending on participants' responses. This approach facilitates the emergence of new insights or contextual variables that may not be anticipated in advance. Each interview lasted approximately 50 to 60 minutes and was conducted either face-to-face or via online videoconferencing, depending on participant availability. Additional probing questions were used where appropriate to elicit deeper contextual understanding.

A distinctive characteristic of in-depth interviewing lies in the researcher's role as a co-creator of meaning rather than a passive collector of data (Charmaz, 2014). Throughout the interviews, the researcher engaged in an interpretive dialogue with participants, constructing narrative understandings of how design processes are embedded within NPD frameworks. This approach enabled the identification of contextual and organisational factors that influence the CDPs in OBM firms, extending beyond descriptive accounts to uncover the underlying relationships between design, organisational culture, and strategic management.

(1) Interviews with international brand representatives focused on design-mature corporations that have systematically integrated design within their organisational strategy. All interviewees possessed over ten years of professional experience in design and had extensive involvement in collaborative projects with external design agencies (Table 3.5). These participants offered insights into how design had been internalised as a strategic capability, how it was integrated into corporate-level decision-making, and how it contributed to innovation outcomes. All three interviews with international brand professionals were conducted face-to-face. The discussions provided valuable benchmarks for identifying transferable design processes that could inform the internal practices of collaborative OBM firms.

Table 3. 5: In-depth interview participants at international brand representatives

Interviewee	Title	Professional experience in design	Involvement in collaborative projects with external design agencies
South Korea – Case 1	Senior design managers	13 years	Y
Japan – Case 2	Senior design managers	11 years	Y
South Korea – Case 3	Design Executive	22 years	Y

(2) Interviews with design agencies were conducted to capture external perspectives on design collaboration, encompassing their work with both international brands and OBM firms. Although design agencies may not oversee the entirety of a client's product development process, they typically assume a leading role during the design phase, making them key informants regarding process execution, challenges, and constraints (Bruce & Morris, 1994; Sunley, Pinch & Macmillen, 2010). Accordingly, the interviews explored the difficulties encountered during design collaboration, organisational and contractual constraints, and potential opportunities for improvement. Four professionals from design agencies were interviewed, three through face-to-face sessions and one online. Each participant had at least ten years of professional experience in design consultancy and had directly led or managed design collaboration projects from conceptualisation through to production and launch (Table 3.6).

Table 3. 6: In-depth interview participants at design agencies

Interviewee	Title	Professional experience in design	Interview type
UK – Case 1	Creative Director	15 years	Face-to-face
UK – Case 2	Creative Director	14 years	Face-to-face
UK – Case 3	CEO	24 years	Online
China – Case 4	CEO	15 years	Face-to-face

The interview sampling was based on purposive sampling, one of the principal non-probability techniques used in qualitative research (Patton, 2002; Teddlie & Yu, 2007). Participants were deliberately selected based on their expertise, relevance to the research objectives, and direct experience with design integration in OBM or international brand contexts. The researcher's professional affiliation with a design consultancy facilitated access to highly experienced individuals with deep contextual understanding of design collaboration practices. This insider position enhanced the depth and relevance of data collection, allowing the study to gather nuanced and contextually rich insights from a relatively small but strategically selected group.

In addition, the interview data were triangulated with documentary analysis and field observation to strengthen the study's validity. This triangulated approach enabled the researcher to move beyond surface-level accounts, uncovering latent patterns, interpretive meanings, and multiple perspectives within the data. Ultimately, the analysis provided an interpretive understanding of the structural and contextual factors influencing the CDP in OBM firms.

3.3.3.2 In-Depth Interviews with OBM firms

The in-depth interviews conducted with OBM firms in this study followed the same methodological procedures as those used for the international brands and design agencies. The primary purpose of these interviews was to explore participants' professional experiences and perceptions in depth, in order to examine how design processes operate within NPD and how they relate to organisational and strategic decision-making.

In-depth interviewing is one of the principal qualitative methods for understanding complex social and organisational phenomena, as it enables researchers to interpret the contextual meanings of participants' experiences, thoughts, and attitudes (Kvale, 1996; Patton, 2015; Seidman, 2013). Within case study research, interviews function as a major source of evidence alongside observation and documentary analysis (Yin, 2018), and they are understood as an interpretive process in which the researcher acts not merely as an information collector but as a co-constructor of meaning (Charmaz, 2014; Merriam & Tisdell, 2015).

This study adopted a semi-structured interview format, which involved preparing key questions in advance while allowing flexibility to adjust their sequence or phrasing according to the participants' responses (Bryman, 2016; Creswell & Poth, 2018). Each interview lasted approximately 50 to 60 minutes and was conducted either face-to-face or online, depending on the interviewee's availability. The researcher employed additional probing questions when necessary to elicit deeper contextual information and clarify meanings. Through this process, the interviews identified several critical factors affecting OBM firms, including challenges in adopting design, the level of organisational understanding of design processes, and constraints arising during collaboration with external design agencies.

The selection of participants focused on OBM firms that had strategically positioned design as a core driver of corporate transformation. All participants had over ten years of professional experience in NPD, had been involved in design-related decision-making within their firms, and had experience collaborating with external design experts. They recognised design as a key instrument for product differentiation and brand identity, and the interviews centred on understanding the challenges OBM firms face, the perceived importance of design within the organisation, and the constraints limiting its strategic use.

In addition, the study included cases from design-mature firms with extensive experience in design integration, in order to examine empirically how the internalisation and institutionalisation of design capabilities occur. All interviews were conducted face-to-face. Participants shared detailed accounts of how design processes were embedded within the entire product development cycle, from conceptualisation to launch, and how these processes contributed to innovation outcomes. The findings provided a practical foundation for identifying structural features and operational mechanisms of design processes that could serve as benchmarks for OBM firms.

The in-depth interviews with OBM firms were conducted as an interpretive process that moved beyond descriptive data collection. They aimed to elucidate the interrelationships between design, organisational culture, and strategic management, providing both theoretical and empirical insights into how design functions as an internal and strategic mechanism that drives innovation performance within OBM firms.

3.3.4 Observation

Participatory observation is a qualitative research method in which the researcher enters the participants' real-world environment to observe their behaviour, interactions, and cultural context, thereby achieving a deep understanding of social phenomena (Spradley, 1980; Kawulich, 2005). Originating in anthropological fieldwork, this approach aims to uncover the meanings, behavioural logics, and non-verbal communications that naturally emerge in people's everyday settings (DeWalt & DeWalt, 2011).

Merriam and Tisdell (2015) define participatory observation as “a process of understanding social interactions and structures of meaning that cannot be captured through language or interviews alone by directly experiencing the context of phenomena.” Yin (2018) further emphasises that in case study research, participatory observation is not merely a supplementary data collection tool but a core procedure that strengthens contextual validity and reveals behavioural realities.

The primary goal of participatory observation is to directly understand how individuals think and act within their natural environment. Unlike interview data, which is mediated through language, this method focuses on uncovering tacit knowledge through the observation of behaviour, habits, spatial use, non-verbal reactions, and patterns of interaction (Kawulich, 2005). Such observation makes it possible to detect underlying discomforts, organisational constraints, informal decision-making structures, and the actual functioning of design processes that may not be explicitly articulated.

Application in this study

In this research, participatory observation was adopted as a supplementary data collection method within a broader case study framework. The researcher participated in the actual work environments and design development sites of the target organisations to explore how design processes operated in practice and how various stakeholders interacted with design within organisational settings.

Participatory observation was conducted across seven organisations, comprising:

- Two international brand corporations,
- One design agency, and
- Four OBM firms.

These organisations were selected through theoretical sampling (Yin, 2018) for their strong relevance to the study’s central theme, “the integration and strategic application of design processes” and to enable comparative analysis of how design functions within differing organisational structures and cultural contexts.

3.3.4.1 Procedures of participatory observation

The participatory observation was implemented across seven case organisations: two international brands, one design agency, and four OBM firms. Depending on the researcher's degree of involvement, six cases followed an active participation model, while one adopted a partial participation model. This classification follows the participation-level typologies proposed by Spradley (1980) and DeWalt & DeWalt (2011), aiming to balance immersion as an insider with analytical detachment as a researcher.

(1) International brand cases

Both international brand cases involved collaborative projects with UK-based design agencies but differed in the level of participation. The observation with International Brand B followed a partial participation model, in which the researcher observed over a six-month period through regular meetings, workshops, and site visits, analysing the collaboration structure, decision-making process, and interdepartmental interactions between design and engineering teams from an external perspective.

Conversely, International Brand C was observed through an active participation model. The researcher joined the project team as a working member for approximately three months, attending weekly design meetings, workshops, and interdepartmental video conferences, enabling real-time observation of organisational decision-making processes.

In both cases, in-house designers from the corporations were seconded to UK design studios as embedded collaborators. Drawing on lived experience in the field, the researcher analysed the evolving dynamics of inter-organisational collaboration and the ways in which design processes mediated cross-departmental interaction.

(2) Design agency case

The observation of Design Agency B represents a case of top-down collaboration with an OBM firm, where the integration between design and engineering departments was closely examined. The researcher acted as an active participant observer throughout the one-month project period, attending biweekly meetings and joint 3D modelling sessions.

The observation focused on patterns of interdepartmental communication, shifts in the locus of design decision-making, and strategies for problem resolution, thereby demonstrating how the design agency internalised creative perspectives within a technology-oriented organisational culture.

(3) OBM firm cases

Participatory observation in the four OBM firms was conducted entirely through the active participation model. The researcher directly engaged in the projects as a design lead or external consultant, closely observing design strategy formulation, interdepartmental collaboration, and the design decision-making processes across product development cycles.

For example:

- OBM A: The researcher participated for approximately 4.5 months, analysing the tension and negotiation between design proposals and engineering validation.
- OBM G: Over a five-month fitness equipment project, the researcher observed how user-centred design principles were incorporated into an engineering-driven development culture.
- OBM I: The collaboration with a robotics manufacturer allowed the researcher to observe how design-led thinking was embedded within a technology-centric system.
- OBM J: The six-month observation of a sensor-technology firm focused on the negotiation between engineering constraints and design-oriented approaches during the company's initial design adoption phase.

Across all cases, data were systematically collected through meeting minutes, field notes, emails and message logs, visual materials (sketches and prototypes), and reflective memos. These were triangulated with interview and documentary evidence (Merriam & Tisdell, 2015; Yin, 2018) to enhance the study's validity and reliability.

The participatory observation procedures contributed to a deeper empirical understanding of how design operates within technology-driven organisational decision structures and how institutional transformation and organisational learning occur through the integration of design in practice.

3.3.5 Data collection procedures

The data collection in this study integrated two complementary sources of qualitative evidence, theoretical data and empirical data, to ensure methodological depth, reliability, and triangulation. This dual-source qualitative approach was designed to strengthen the validity of the findings and to provide a comprehensive understanding of how design processes operate and become embedded within the organisational context of OBM firms (Yin, 2018; Gray, 2014).

The theoretical data provided the conceptual foundation for the study through an extensive and critical literature review, while the empirical data were obtained through qualitative methods including case studies, semi-structured in-depth interviews, and participatory field observations. This integration of theoretical and empirical inquiry reflects an interpretivist qualitative design aimed at generating contextually grounded understanding rather than statistical generalisation.

1) Theoretical data collection through literature review

The literature review constituted the first stage of qualitative data collection and served as a critical procedure for establishing the theoretical foundation and analytical framework of this research. According to Hart (2018), a literature review is “an academic act of managing knowledge and reconstructing meaning to generate new scholarly insight,” while Neuman (2014) defines it as “a process of structuring knowledge to interpret social reality.” In this respect, the literature review in this study was not limited to summarising prior work; it sought to critically interpret and synthesise existing scholarship in design management, organisational learning, innovation theory, and design processes to reveal theoretical limitations and identify research gaps.

Following systematic procedures proposed by Gray (2014) and Snyder (2019), relevant sources were identified through comprehensive searches of peer-reviewed journals, academic books, doctoral theses, policy reports, and professional publications. Each source was evaluated in terms of relevance, scholarly credibility, objectivity, purpose, and citation impact (Neuman, 2014). Guided by Hart’s (2018) conceptual framework for structuring knowledge, the selected

literature was thematically categorised and mapped, which revealed a notable paucity of empirical studies addressing the integration of design processes within manufacturing-oriented OBM firms (Tsai & Hung, 2010; Zhang & Zhang, 2012).

As a result, the literature review established three central analytical axes that structured the qualitative inquiry of this study:

- The relationship between design management and organisational learning;
- The mechanisms of CDP during OBM transformation; and
- The staged development of design maturity and organisational capability.

Thus, the literature review functioned not only as a theoretical exploration but also as a qualitative data collection process that shaped the analytical orientation and conceptual boundaries of the empirical investigation (Torraco, 2005; Whitemore & Knafl, 2005).

2) Empirical data collection through case study research

The case study research in this study aimed to examine the operational and organisational integration of design processes within real-world industrial contexts. It employed qualitative methods exclusively, enabling an in-depth and interpretive understanding of how design practices are embedded within organisational structures and strategic decision-making systems (Yin, 2018; Gray, 2014).

Empirical data were collected using three principal qualitative methods: semi-structured in-depth interviews, participatory observation, and document analysis. Each method was selected for its ability to capture different dimensions of the design process, ensuring methodological triangulation and enhancing the trustworthiness of the findings.

3) Semi-structured interviews

Semi-structured interviews were conducted with design managers, engineers, executives, and external consultants. The interviews explored participants' perceptions of design-related decision-making, collaborative mechanisms, interdepartmental communication, and the strategic use of design in organisational contexts. This approach allowed for the flexible exploration of emerging themes while maintaining a structured alignment with the core

research questions (Kvale & Brinkmann, 2009; Seidman, 2013). Interviews typically lasted between 60 and 90 minutes and were audio-recorded and transcribed verbatim to facilitate detailed thematic analysis.

4) Participatory observation

Participatory observation was undertaken in live project settings such as design meetings, workshops, and cross-functional collaboration sessions. The researcher observed and documented real-time interactions, informal communication patterns, and cooperative problem-solving processes, thereby gaining insights into how design was operationalised and negotiated within organisational realities. These observations helped contextualise the interview data and offered a nuanced understanding of the social and procedural dynamics of design integration (Emerson, Fretz, & Shaw, 2011; DeWalt & DeWalt, 2011).

5) Document analysis

Document analysis was conducted following Bowen's (2009) qualitative document review method. Organisational materials such as internal reports, design briefs, process manuals, and project deliverables were examined to trace procedural characteristics, design management evolution, and the longitudinal embedding of design processes within OBM firms. Document analysis served both as an independent data source and as a means of triangulating insights from interviews and observations, contributing to a holistic understanding of each case.

Together, these qualitative methods formed an iterative and reflexive data collection framework, in which insights from one method informed and refined subsequent stages of inquiry. Interviews provided interpretive depth, participatory observation revealed the contextual and behavioural aspects of design integration, and document analysis offered longitudinal and organisational evidence. Through this iterative interaction, the research generated a multi-layered and contextually grounded understanding of how design becomes institutionalised as a strategic and operational capability within OBM firms.

In-depth interviews were employed as the principal qualitative method to uncover how design processes function within organisations and how decision-making is shaped through human experience, perception, and interaction (Kvale, 1996; Patton, 2015). As Bryman (2016) notes, a semi-structured interview format provides both structure and flexibility, enabling

comparability across participants while allowing them the freedom to express individual perspectives and contextual insights.

The interview procedure followed a systematic and iterative sequence designed to ensure depth, reflexivity, and interpretive reliability.

First, interview questions were derived from the conceptual constructs identified during the literature review, particularly those concerning design management, organisational learning, and OBM transformation. The questions were open-ended to elicit detailed narratives about participants' experiences, decision-making logics, and perceptions of design integration.

Second, drawing upon the logic of multiple case study research (Eisenhardt, 1989; Stake, 1995), interview participants were selected from three key groups: international brands, design consultancies, and OBM firms. This multi-perspective design enabled the identification of cross-contextual patterns and distinctions in how design is operationalised as a strategic capability.

Third, interviews were conducted following Seidman's (2013) narrative interviewing approach, focusing on participants' lived experiences of collaboration, cross-functional communication, and organisational change. This approach provided rich interpretive data on how design roles evolve and interact with management systems and innovation practices.

Fourth, immediately after each interview, the researcher produced analytical and reflexive memos in accordance with Charmaz's (2014) grounded theory methodology. These memos served to capture emergent interpretations, researcher reflections, and preliminary analytical insights, thereby supporting a continuous, iterative engagement with the data.

Finally, interview findings were triangulated qualitatively with insights from participatory observation and document analysis to ensure consistency and interpretive validity. This process of cross-verification strengthened the trustworthiness and credibility of the analysis without resorting to quantitative validation techniques, thereby maintaining the coherence of the qualitative research design (Yin, 2018; Merriam & Tisdell, 2015).

The in-depth interviews functioned not merely as tools for gathering participants' accounts but as interpretive instruments for uncovering the cultural, cognitive, and social mechanisms through which design processes are enacted and institutionalised within organisational contexts. Through the iterative engagement between data and reflection, the interviews illuminated the lived realities of design practice in OBM firms and their partner organisations, thereby contributing directly to the construction of the study's analytical framework.

6) Data collection through observation

Observation was conducted to obtain a first-hand and contextually grounded understanding of behavioural, procedural, and interactional dynamics that could not be fully captured through verbal accounts. It provided a direct empirical foundation for analysing the lived reality of design collaboration and decision-making within organisational environments (Angrosino, 2007; Kawulich, 2005).

Drawing on Spradley's (1980) typology of researcher participation, the study employed a combination of participatory and non-participant observation. Observations were undertaken during design workshops, prototyping sessions, review meetings, and interdepartmental collaborations across selected case organisations. Key aspects observed included behavioural patterns, communication flows, decision-making processes, team coordination, and non-verbal interactions.

Field notes were recorded contemporaneously, following the systematic procedures outlined by Emerson, Fretz, and Shaw (2011), and reflective analytical memos were written immediately after each observation session. These memos captured the researcher's interpretive insights and evolving theoretical reflections, consistent with qualitative reflexivity principles (Finlay, 2002).

All observational data were triangulated with interview transcripts and documentary materials to ensure interpretive coherence and contextual validity (Denzin, 1978; Yin, 2018). This triangulation facilitated the identification of tacit knowledge, relational dynamics, and organisational learning mechanisms embedded within the design process. Observation therefore functioned not as a supplementary technique but as a core qualitative instrument for

revealing how design processes are enacted, negotiated, and institutionalised within OBM firms.

In summary, the data collection procedures comprised four interrelated qualitative components:

- 1) theoretical foundation building through an extensive literature review;
- 2) contextual inquiry through qualitative case study research;
- 3) experiential understanding through in-depth interviews; and
- 4) behavioural and organisational exploration through participatory observation.

7) Summary and interpretive conclusion

This multi-layered qualitative design established a recursive and interpretive relationship between theoretical development and empirical inquiry. Rather than pursuing statistical verification, the study sought contextually grounded understanding through iterative reflection between conceptual frameworks and field evidence. By integrating these complementary approaches, the research achieved methodological depth and interpretive richness, enabling a holistic examination of how design processes are embedded, enacted, and institutionalised within OBM firms.

This structure reinforces the coherence between theory, practice, and organisational context, advancing the methodological maturity of design process research within qualitative inquiry. It positions the study as both analytically rigorous and reflexively grounded, contributing to an expanded understanding of design as a strategic and cultural mechanism for innovation capability in OBM firms.

The assessment phase of this study was designed to examine the cognitive clarity, pragmatic validity, and contextual appropriateness of the four design processes developed for OBM firms. The primary purpose of this phase was not to measure performance quantitatively but to explore how clearly each process could be understood, interpreted, and applied by its intended users, design professionals and OBM practitioners. To achieve this, a closed qualitative interview approach was adopted to elicit participants' interpretive judgements and contextual perceptions regarding the practical relevance and usability of each process (Kvale, 1996; Patton, 2015; Seidman, 2013).

This assessment was grounded in an interpretivist epistemological stance, recognising that the effectiveness of a design process should be understood not through procedural completeness or output metrics, but through the lived experiences, reflective interpretations, and situated meanings of practitioners (Stake, 1995; Charmaz, 2014). Accordingly, the design process was conceptualised as a dynamic social practice, continuously shaped and reconstructed through organisational interactions and implementation (Yin, 2018).

From this philosophical position, the assessment aimed to determine whether each design process could be comprehended, accepted, and meaningfully integrated into real organisational contexts. Therefore, two principal qualitative criteria were established:

- Pragmatic validity: the degree to which each process resonates with practitioners' experience and proves useful in real-world application; and
- Contextual fit: the extent to which the process aligns with organisational culture, resources, and existing workflows.

The assessment interviews were conducted face-to-face with four participants, purposefully selected from the pool of prior interviewees to ensure balanced representation between design and organisational perspectives:

- Two OBM practitioners, each responsible for product planning or design management, with direct experience in operating internal design processes;
- Two design experts, senior consultants with extensive international project experience and prior collaboration with OBM firms.

This composition allowed the inclusion of both internal organisational viewpoints and external consultancy perspectives, facilitating comparative interpretation of design process applicability and strategic relevance. All participants possessed more than ten years of professional experience and direct involvement in design project management or process development.

The closed qualitative interview approach (Kvale, 1996; Seidman, 2013) combined a structured questioning framework with interpretive flexibility, allowing participants to articulate nuanced professional reflections. The interview protocol was structured around four core assessment dimensions, formulated to examine the clarity, usability, usefulness, and contextual resonance of each proposed design process:

- 1) Comprehensibility: whether the process structure, stages, and terminology were clearly understood by practitioners.
- 2) Usability: whether the process could be practically followed with clarity and procedural ease.
- 3) Usefulness: whether the process supported decision-making, collaboration, and problem-solving in real contexts.
- 4) Contextual appropriateness: whether the process aligned with the organisation's resources, culture, and workflow.

Each interview lasted approximately 60 minutes and was audio-recorded with participants' informed consent. Sessions were conducted in private meeting rooms to provide a reflective and uninterrupted environment. The audio data were transcribed verbatim and analysed using thematic analysis following the framework proposed by Braun and Clarke (2006).

The analysis began with the identification of meaning units, followed by open coding, in which conceptual labels were assigned to key ideas and practitioner comments (Charmaz, 2014). This was followed by axial coding, which explored the conceptual relationships among the four assessment dimensions, comprehensibility, usability, usefulness, and contextual appropriateness, leading to an integrative understanding of practitioner perspectives.

Through this process of reflexive synthesis, the assessment confirmed the practical validity and organisational feasibility of the proposed design processes. The findings from this stage provided the qualitative foundation for the subsequent refinement of the design process framework, ensuring conceptual robustness, interpretive depth, and contextual applicability within OBM organisational settings.

3.3.7 Qualitative data analysis

The data analysis in this study was grounded in an interpretivist qualitative paradigm, integrating data collected through the literature review, case studies, in-depth interviews, participatory observations, and assessment sessions. The analytical framework was primarily guided by thematic analysis, as articulated by Braun and Clarke (2006), while content interpretation and cross-case comparison were employed as complementary techniques to

reveal the multilayered meanings embedded within the data. This composite analytical approach reflected both the diversity of qualitative data sources and the complexity of organisational contexts. It applied iterative cycles of inductive and abductive reasoning to generate interpretive insights and theoretical understanding from field-based qualitative evidence (Charmaz, 2014; Braun & Clarke, 2006; Miles, Huberman, & Saldaña, 2014).

1) Overview and analytical procedure

The principal analytical method employed in this study was thematic analysis, following the framework proposed by Braun and Clarke (2006). Thematic analysis is one of the most widely adopted interpretive methods in qualitative research. It is particularly effective in systematically identifying meaning patterns within qualitative data and organising them into coherent thematic structures that reflect the essence of a phenomenon.

This study adapted Braun and Clarke's six-phase analytical model to a five-stage sequential procedure, refined to fit the study's specific context (Braun & Clarke, 2006; Nowell et al., 2017). The five stages comprised familiarisation, coding, theme generation, theme review and definition, and final synthesis and interpretation.

(a) Familiarisation and identification of meaning units

All interview and observation data were transcribed verbatim. The researcher immersed themselves in the data through repeated reading to identify key meaning units, segments that reflected participants' perceptions, emotions, behaviours, and collaborative experiences within their organisational contexts.

(b) Generating initial codes

Systematic coding was conducted around the identified meaning units. Each code represented a conceptual label capturing the essential meaning of a data segment. The researcher minimised preconceived theoretical assumptions and preserved participants' authentic expressions to maintain interpretive credibility (Braun & Clarke, 2006).

(c) Searching for potential themes

The initial codes were grouped according to conceptual affinities, forming preliminary thematic categories. This stage involved exploring relationships among codes, examining their

relevance to the research questions, and identifying emergent structural patterns across organisational and design contexts.

(d) Reviewing and defining themes

The identified themes were iteratively reviewed to ensure internal coherence and representational accuracy across the full dataset. Redundant or ambiguous themes were refined, merged, or removed. A final set of theoretically meaningful and contextually grounded themes was then established.

(e) Synthesising and interpreting results

In the final stage, the confirmed themes were interpreted within the study's theoretical framework, linking empirical insights to conceptual constructs such as design management, organisational learning, and innovation capability. The researcher strengthened contextual understanding by incorporating narrative evidence and direct quotations from participants, while cross-case comparison enhanced interpretive depth and analytical validity (Yin, 2018; Miles, Huberman, & Saldaña, 2014).

This analytical process transcended mechanical coding, engaging deeply with the interpretive texture of the data. It examined how participants' meanings, organisational practices, and design processes interacted to construct a shared understanding of design as an operational and strategic mechanism. Ultimately, the thematic analysis upheld the principles of qualitative rigour, reflexivity, credibility, and transparency, capturing both the narrative depth and contextual complexity inherent in design practice within organisational environments.

2) Rationale for analytical method selection

The use of thematic analysis was justified by its methodological suitability for examining complex, multilayered organisational and social phenomena such as design process integration. It provides a rigorous interpretive structure for analysing rich narrative and observational data while allowing integration across multiple qualitative sources (Braun & Clarke, 2006; Nowell et al., 2017).

Moreover, thematic analysis supports both inductive discovery, which generates grounded conceptual categories from the data, and abductive refinement, which links emerging categories to established theoretical frameworks. This dual interpretive logic aligns with the

study's customised three-stage research process, which follows a cyclical structure of exploration, interpretation, and refinement.

The analytical framework corresponded with the Double Diamond logic, operationalised through three research stages:

- (a) Foundation (Awareness and Discover),
- (b) Development (Develop and Assessment), and
- (c) Refinement (Refining and Deliver).

Throughout these stages, thematic analysis facilitated the identification of emerging patterns, the theoretical linkage of insights, and the progressive refinement of interpretive structures. It served as a methodological bridge between empirical data and conceptual synthesis, ensuring analytical coherence between practice-based observations and theoretical reasoning.

3) Comparison between computer-assisted and manual analysis, and justification for methodological choice

In contemporary qualitative inquiry, Computer-Assisted Qualitative Data Analysis Software (CAQDAS) such as NVivo, ATLAS.ti, and MAXQDA is frequently used to manage extensive textual datasets efficiently. These tools facilitate data organisation and retrieval, as well as visualisation of relationships among codes (Silver & Lewins, 2014; Bazeley & Jackson, 2013). While they enhance systematic transparency and reproducibility, they inherently lack sensitivity to contextual meaning and emotional nuance (Saldaña, 2016).

For example, automated tools cannot interpret non-verbal cues such as silence, laughter, or hesitation, nor can they capture the subtleties of tone, metaphor, or atmosphere that are essential in understanding organisational and interpersonal dynamics (Charmaz, 2014). When used mechanistically, CAQDAS may reduce interpretive richness to code frequency or co-occurrence matrices, resulting in analytic superficiality.

In contrast, manual (hand-coded) analysis allowed the researcher to engage directly with the text, maintaining interpretive depth and contextual sensitivity. Manual coding constituted an iterative hermeneutic dialogue between the researcher and data (Coffey & Atkinson, 1996), enabling the recognition of symbolic meaning, narrative flow, and affective resonance,

dimensions crucial for interpreting creative collaboration and design-oriented interaction (Braun & Clarke, 2006; Charmaz, 2014).

Manual analysis also encouraged reflexive engagement: the researcher recorded reflective memos at each coding stage to articulate interpretive reasoning and guard against bias (Miles, Huberman & Saldaña, 2014; Nowell et al., 2017). This approach strengthened the study's trustworthiness and interpretive transparency.

Given these methodological considerations, the present study deliberately adopted manual hand-coding as its primary analytical method.

- First, the data collected from interviews, observations, and evaluation sessions were narrative-rich and contextually embedded, unsuitable for reduction into numerical or frequency-based structures (Charmaz, 2014).
- Second, as an insider researcher, the author possessed tacit knowledge of design practice and organisational culture, allowing nuanced interpretation of the subtleties of collaborative communication and design decision-making (Miles et al., 2014).
- Third, manual analysis aligned naturally with the study's customised three-stage research process, in which conceptual insights from the Foundation stage were validated and expanded through coding in the Development stage, and refined into a cohesive model in the Refinement stage.

Manual coding was not a procedural convenience but a philosophically and epistemologically grounded choice that upheld the interpretivist nature of the research. It provided analytical coherence linking theory, practice, and organisational context, allowing the identification of micro-level mechanisms that underlie design process implementation and learning within firms.

4) Data integration and interpretive strategy

All qualitative data were analysed through within-case and cross-case synthesis. Within-case analysis examined the contextual characteristics and internal dynamics of each organisation, while cross-case comparison identified both recurring interpretive patterns and distinctive variations (Eisenhardt, 1989; Yin, 2018).

A reflexive integration strategy was adopted to synthesise diverse qualitative evidence, interviews, participatory observations, documents, and assessment reflections, into a unified interpretive framework. This iterative process enabled a multi-perspective understanding of how design processes were enacted, negotiated, and institutionalised across different organisational and cultural contexts (Miles, Huberman, & Saldaña, 2014).

The integrative analysis went beyond descriptive categorisation to develop theoretical linkages among design capability, organisational learning, and innovation. Through this interpretive synthesis, the study demonstrated how design processes within OBM firms evolve from operational practices into embedded organisational knowledge systems, thereby contributing to innovation capability and long-term strategic development.

3.3.8 Reliability and validity

Ensuring the reliability and validity of this study was a central methodological concern, particularly given its multi-phase qualitative design encompassing literature review, case studies, in-depth interviews, participatory observation, and assessment reflection. Following Lincoln and Guba's (1985) framework for establishing trustworthiness, the study adopted an integrated set of strategies to secure credibility, dependability, confirmability, and transferability (Creswell & Poth, 2018). These principles were systematically embedded throughout the customised three-stage research process; Foundation, Development, and Refinement to ensure philosophical, methodological, and interpretive coherence across all phases of data collection, analysis, and synthesis.

1) Methodological rigour and triangulation

Rigour was achieved through systematic triangulation, reflexive documentation, and iterative analytical transparency. Following Denzin's (2012) model, triangulation was implemented at three complementary levels:

(a) Data triangulation:

Multiple qualitative data sources, including interviews, participatory observations, document analyses, and assessment reflections, were integrated to achieve interpretive depth and

contextual trustworthiness. This convergence of perspectives enhanced the richness and credibility of findings across different organisational and cultural settings.

(b) Methodological triangulation:

Distinct qualitative techniques were purposefully combined to capture multiple dimensions of the phenomenon. Semi-structured interviews yielded narrative and perceptual insights, while participatory observation illuminated tacit behavioural and relational dynamics. Document analysis further contextualised these insights by tracing procedural structures and organisational artefacts, thereby reinforcing the interpretive coherence of the analysis (Patton, 2015; Creswell & Poth, 2018).

(c) Theoretical triangulation:

Analytical interpretation was guided by the complementary perspectives of design management theory (Bruce & Bessant, 2002) and organisational learning theory (Argyris & Schön, 1996). This dual-theoretical orientation provided a multidimensional interpretive lens that connected design process integration with capability development, adaptive learning, and innovation mechanisms within OBM firms.

Through these interlocking strategies, the study maintained methodological integrity and interpretive rigour. Reflexivity functioned as an ongoing process of self-examination, ensuring that the researcher's positionality, assumptions, and interpretive judgements were explicitly documented and critically evaluated. Thus, the reliability and validity of this study were not treated as static technical measures but as evolving outcomes of transparency, contextual sensitivity, and interpretive depth, consistent with the epistemological commitments of qualitative inquiry.

2) Reliability assurance

Reliability was reinforced through systematic qualitative procedures, transparent documentation, and peer review. All stages of data collection adhered to consistent ethical and procedural guidelines, including participant consent, anonymisation, and secure data handling. Analytical reliability was supported by version-controlled codebooks that tracked the evolution

of coding structures and theme development across iterative analytical cycles (Miles, Huberman, & Saldaña, 2014).

Peer debriefing sessions were conducted at critical analytical junctures, allowing interpretive comparisons and discussion of emergent themes. These sessions enhanced reflexivity and ensured the coherence of thematic interpretations. Furthermore, a detailed audit trail recorded coding decisions, memo revisions, and analytical refinements, enabling transparency and interpretive traceability throughout the research process (Nowell et al., 2017). This rigorous documentation provided a verifiable basis for methodological integrity and allowed subsequent readers to follow the reasoning process in depth.

3) Validity assurance

Validity was ensured through a set of interrelated strategies, member checking, reflexive memoing, peer debriefing, and thick description each contributing to the interpretive integrity and contextual authenticity of the findings. Together, these approaches address both internal validity (credibility and interpretive coherence) and external validity (transferability and analytical generalisation across contexts).

- Member checking: Interim thematic structures and analytical interpretations were shared with selected participants to confirm interpretive resonance, factual accuracy, and contextual alignment (Lincoln & Guba, 1985).
- Reflexive memoing: Throughout data analysis, the researcher systematically documented evolving assumptions, theoretical reflections, and positional considerations, thereby making interpretive stances explicit and reducing the risk of bias (Charmaz, 2014).
- Peer debriefing: Independent scholars reviewed the coding process and thematic synthesis, providing constructive critique that enhanced analytical rigour and conceptual robustness.
- Thick description: Detailed contextual narratives were constructed to capture the behavioural, organisational, and cultural depth of each case, enabling readers to understand findings within their situational specificity while supporting analytical transferability (Stake, 1995; Yin, 2018).

This multi-layered validation strategy ensured that validity was not understood as statistical generalisability but as interpretive coherence, contextual fidelity, and cross-national transferability. By grounding the findings in the empirical realities of South Korean OBM firms while maintaining theoretical resonance with broader East Asian industrial contexts, the study establishes analytical generalisation that is regionally meaningful and conceptually robust.

4) Iterative validation within the customised research process

Validation was embedded iteratively within each stage of the customised three-stage research process.

- Foundation stage: Triangulated insights from the literature and exploratory interviews ensured conceptual validity and theoretical alignment.
- Development stage: Coding and thematic synthesis were repeatedly refined through internal peer discussions and cross-case comparisons, ensuring that emerging patterns remained grounded in the qualitative data.
- Refinement stage: Feedback from assessment sessions with design experts and OBM practitioners functioned as a dialogic validation loop, confirming the practical relevance, clarity, and contextual appropriateness of the final CDP.

This iterative approach to validation continued until theoretical saturation was achieved—that is, when no new conceptual categories or interpretive relationships emerged from subsequent data analysis (Glaser & Strauss, 1967). The resulting process was empirically grounded, theoretically coherent, and contextually applicable, providing a credible and reflexively constructed account of collaborative design integration within OBM organisations.

3.3.9 Research Ethics

This study was conducted in full accordance with the ethical principles and procedural standards outlined in Brunel University London's Code of Ethics for Research (BUL, 2013). Ethical considerations were integrated throughout every stage of the research, from conceptual design to data collection, analysis, and dissemination, to ensure the protection of participants' rights, dignity, and well-being.

Prior to commencing fieldwork, the researcher completed the Ethics and Research Integrity Training Programme (BBL, 2017), which provided a comprehensive foundation in the ethical implications of qualitative research and the professional responsibilities of researchers. Following this preparation, the study underwent a full ethics review and received formal approval from the Brunel University Research Ethics Committee, being classified as a low-risk qualitative study. The research did not involve any quantitative survey, experiment, or participation from vulnerable groups unable to provide informed consent.

All participants received a detailed Participant Information Sheet outlining the study's purpose, scope, and procedures, as well as their rights to voluntary participation, confidentiality, and withdrawal at any stage without penalty. Prior to each interview or observation session, participants were asked to provide written informed consent after a full explanation of the study's objectives, data handling procedures, and intended use of their anonymised contributions.

Confidentiality and anonymity were rigorously upheld. All identifying details in transcripts and observation notes were replaced with pseudonyms, and sensitive information was removed or generalised to prevent any potential traceability. Data were stored securely in encrypted digital folders accessible only to the researcher. Upon completion of the study, all personally identifiable information was permanently deleted in accordance with the UK Data Protection Act (2018) and Brunel University's Data Management Policy.

Throughout the fieldwork, the researcher maintained professional neutrality, reflexivity, and transparency in all interactions with organisational and industry participants. Ethical engagement extended beyond procedural compliance to include relational and interpretive responsibility, acknowledging the co-constructed nature of meaning in qualitative research. Direct quotations and case descriptions presented in this thesis were carefully anonymised to ensure that neither individuals nor organisations could be identified.

In this way, the research not only satisfied formal ethical requirements but also embodied the principles of respect, integrity, and reflexivity, which underpin responsible qualitative inquiry. The researcher's ethical stance was thus inseparable from the interpretive process, ensuring that every stage of the study remained consistent with both institutional standards and the philosophical foundations of interpretivist research.

3.4 Chapter summary

This chapter has outlined the methodological framework, philosophical orientation, and procedural design adopted to investigate how design processes are strategically embedded and operationally managed within OBM firms and their partner organisations. Grounded in an interpretivist qualitative paradigm, the study employed a multi-method strategy integrating literature review, multiple case studies, semi-structured interviews, participatory observation, and qualitative assessment. This methodological structure enabled a holistic and contextually grounded understanding of design as both a cognitive process and an organisational practice.

The research followed a customised three-stage process; Foundation (Awareness & Discover), Development (Develop & Assessment), and Refinement (Refining & Deliver), establishing a coherent, iterative framework that linked theoretical insight with empirical exploration. Each stage played a distinct yet interconnected role: the Foundation stage developed the conceptual grounding through literature review and exploratory fieldwork; the Development stage involved qualitative data collection and thematic analysis leading to the formulation and interpretive assessment of a preliminary design process; and the Refinement stage synthesised practitioner and expert feedback to produce an improved framework for design process integration within OBM contexts.

Data analysis was conducted through thematic and cross-case synthesis, ensuring interpretive depth while maintaining analytical comparability across different organisational settings. Methodological rigour was ensured through triangulation across data sources, methods, and theoretical perspectives, complemented by member checking, peer debriefing, reflexive memoing, and audit trail documentation to enhance credibility and interpretive transparency. Ethical integrity was rigorously maintained in accordance with Brunel University London's Code of Ethics for Research (BUL, 2013), ensuring voluntary participation, anonymity, and secure handling of all collected materials.

By integrating rigorous methodological design with interpretive and contextual sensitivity, this chapter established the epistemological and methodological foundations of the study. It demonstrates how the research design coherently combines theoretical reasoning, empirical

inquiry, and reflexive synthesis to construct a nuanced understanding of CDP within OBM firms and their collaborative ecosystems.

The next chapter presents the empirical findings, examining how design is enacted, negotiated, and institutionalised across international brands, design agencies, and OBM firms. Through this analysis, Chapter 4 extends the understanding of design as a strategic and cultural mechanism for organisational learning, innovation, and capability development.

Chapter 4. Design process in international brands and design agencies

4.1 Introduction

This chapter presents a comparative case study analysis of design processes as implemented within two distinct but interrelated contexts: multinational corporations, hereafter referred to as International Brand A, B, and C, and external design consultancies, designated as Design Agencies A, B, C, and D. The international brands were selected for their representative trajectories in transitioning from OEM to OBM, and for their strategic use of in-house design teams to embed design into business strategy. The design agencies were included as they exemplify diverse methodological orientations and collaborative processes through which external expertise supports innovation, capability-building, and brand differentiation in client firms. Together, these cases provide a comprehensive cross-section of how design is mobilised both internally and externally to advance product development and corporate competitiveness.

The literature on design processes highlights the proliferation of structured models within both academic theory and industrial practice. Over recent decades, firms have adopted formalised management methodologies, such as Six Sigma, Total Quality Management (TQM), Lean, and Kaizen, to enhance efficiency and reliability. Simultaneously, design has been reframed as a strategic resource, driving innovation and customer value creation. Within multinational corporations, this has led to the institutionalisation of in-house design teams tasked with ensuring alignment between product development, brand identity, and organisational strategy. For design consultancies, the emphasis has been on methodological flexibility, client-specific adaptation, and knowledge transfer, positioning design as a relational and context-sensitive practice that extends beyond aesthetic output to encompass strategic problem-solving.

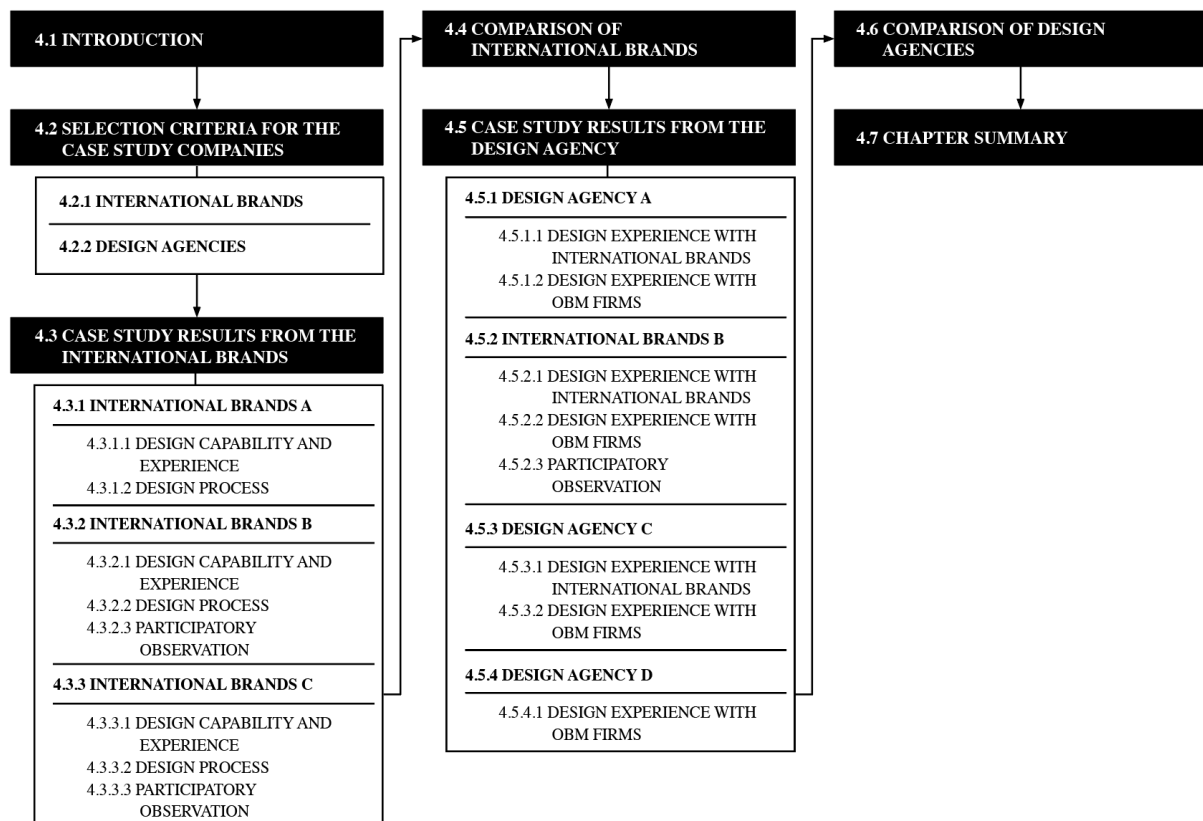
The design process can be conceptualised as a framework for managing workflows, decision-making, and communication across diverse stakeholders. At its core, it involves iterative stages including problem definition, market and user research, idea generation, concept development, prototyping, testing, and implementation. However, the mode of execution differs significantly depending on whether the process is situated within an internal corporate team or mediated by an external design consultancy. Internal teams benefit from organisational proximity, access to

confidential information, and integration with long-term strategy, but may face challenges of insularity and limited exposure to external perspectives. External agencies, by contrast, bring creative independence, cross-sectoral expertise, and fresh insights, but must overcome barriers related to tacit knowledge, cultural fit, and information asymmetry.

Maximising the effectiveness of design processes thus requires both internal and external dimensions to be considered. In-house teams ensure structural consistency and strategic alignment, while design consultancies act as catalysts for innovation, facilitating the inflow of new knowledge, design methodologies, and user insights. The comparative analysis of these two spheres highlights the importance of balancing creativity and efficiency, exploration and exploitation, and standardisation and flexibility.

The case studies presented in this chapter illustrate how international brands and design agencies approach these challenges in practice. International brands demonstrate the value of early-stage design integration and cross-functional collaboration, reducing inefficiencies and strengthening corporate identity. Design agencies exemplify adaptive methodologies, iterative processes, and relational modes of engagement that enable OBM firms to compensate for capability gaps and accelerate their innovation trajectories. Taken together, these insights provide a holistic understanding of the design process as both an internal corporate function and an external strategic service, underscoring its centrality to long-term brand competitiveness and organisational transformation.

Figure 4.1 Overview of the overall structure and procedural flow of this chapter.



[Figure 4. 1: Chapter map]

4.2 Selection criteria for the case study companies

4.2.1 International brands

The selection of International Brand A, B, and C for this study was grounded in their distinctive approaches to integrating design as a strategic resource and their documented success in transitioning from OEM to OBM (Table 4.1). These firms were deliberately chosen to reflect variation in industrial heritage, geographic origin, and organisational scale, while maintaining comparability in terms of their role as global leaders.

The companies share several defining characteristics that establish them as appropriate case studies. First, each demonstrates a clear trajectory of industrial upgrading, either through a successful OEM-to-OBM transformation or by sustaining OBM practices alongside manufacturing expertise. Second, they have all achieved global recognition in their respective markets, thereby ensuring that their practices offer insights beyond localised contexts. Third, they have institutionalised design within their organisational structures, establishing in-house

design teams that play central roles in product development and strategic planning. Finally, they represent a balance of perspectives across the East Asian industrial landscape, including two South Korean multinationals and one Japanese corporation, thus providing scope for comparative analysis.

The case studies further illustrate that the integration of design is not solely about improving product aesthetics but is fundamentally linked to organisational competitiveness. Internal design teams in these firms engage from the earliest stages of product planning, reducing inefficiencies caused by late-stage revisions and fostering greater alignment with market expectations. Their design activities influence both tangible outcomes, such as product form and function, and intangible assets, including brand identity, customer loyalty, and innovation reputation.

The professionalisation of design operations and refinement of internal frameworks are also closely tied to business performance. Research by Kanno and Shibata (2013) demonstrates that firms which systematically align design with strategic objectives achieve higher success rates in product development, while simultaneously strengthening brand loyalty and consumer satisfaction. These findings reinforce why International Brand A, B, and C represent appropriate and compelling cases for examining the integration of design processes in multinational corporations.

Table 4. 1: Case study descriptions

Criteria	International Brand A	International Brand B	International Brand C	Comparative insights
Historical trajectory	Transitioned from OEM to OBM in the mid-1980s, representing a paradigm shift in East Asian manufacturing	Founded in Japan, with early specialisation in optical glass and precision instruments	Established in South Korea as a consumer appliance manufacturer, initially OEM-focused before strategic OBM transition	A and C illustrate the OEM-to-OBM shift in consumer electronics; B offers a longer legacy rooted in technological specialisation
Core industry focus	Consumer electronics (global leader across product categories)	Precision optics and imaging technologies	Consumer electronics and home appliances (radios, TVs, refrigerators, air conditioners)	A and C emphasise electronics diversification, B demonstrates niche dominance in imaging
Role of design	Strategic driver of brand	Integration of design with engineering to	Institutionalised global design network with 600+	A highlights design as a competitive repositioning tool,

	differentiation and global expansion	advance innovation and sustain brand integrity	in-house designers across multiple countries	B as a technological enabler, C as a globally distributed organisational capability
Market strategy	Established brand identity to expand international influence	Built reputation through continuous innovation and product quality in imaging	Strengthened domestic and global presence, with emphasis on US and Chinese markets	All three pursued globalisation, but with different focal geographies and strategies
Design integration model	Centralised in-house teams guiding early-stage planning	Technology-driven design aligned with R&D excellence	Decentralised yet coordinated global design hubs enabling local responsiveness and global cohesion	Contrasting organisational models illustrate varying ways of embedding design strategically
Significance for OBM research	Exemplar of East Asian OEM-to-OBM transformation	Illustration of brand longevity through design-led technological innovation	Case of large-scale institutionalisation of design as a global capability	Together they provide complementary insights into design as strategy, process, and organisational infrastructure

4.2.2 Design agencies

The selection of design agencies as case study subjects is grounded in the theoretical and empirical recognition of their pivotal role within contemporary product development ecosystems (Table 4.2). As Bruce and Morris (1994) define, external design agencies are entities with design capabilities located outside of the client organisation, engaged to undertake specific design tasks aligned with the strategic needs of the firm. Their involvement is not merely operational, but increasingly strategic, as they contribute creative solutions unencumbered by internal politics, while simultaneously facilitating the transfer of external knowledge into corporate contexts. Although concerns such as the risk of misinterpretation of tacit knowledge or potential confidentiality breaches persist, the integration of external agencies remains a critical mechanism for embedding new perspectives and accelerating innovation capacity.

Building upon this foundation, scholars such as Veryzer and Borja de Mozota (2005) have further conceptualised design consultancies as catalysts for organisational learning, absorptive capacity, and the balance between exploratory and exploitative innovation. In this regard, design agencies extend beyond providing aesthetic or functional enhancements, serving instead

as strategic partners that directly contribute to brand differentiation, long-term competitiveness, and capability building. Similarly, Bruce and Docherty (1993) emphasise the cross-sectoral expertise of external agencies, underscoring their neutrality, cost efficiency, and ability to accumulate and transfer knowledge through sustained collaboration with client firms. This dual position, as both external collaborators and embedded knowledge carriers, highlights the importance of their careful selection for case study research.

Synthesising these academic perspectives, the design agencies included in this research were selected according to four interrelated criteria. First, agencies were required to demonstrate multidisciplinary expertise across industrial design, interaction design, branding, and innovation strategy. In particular, within the empirical context of this study, the consumer electronics sector, competence in integrating complex hardware requirements with digital interface design and coherent brand communication was regarded as essential. These capabilities were verified through each agency's portfolio and publicly available information regarding their collaborations with client companies.

Second, the selected agencies are distinguished by their proven record of collaboration with globally recognised manufacturers. Their portfolios indicate comprehensive engagement throughout the entire product development lifecycle, from early concept generation to prototyping, production specifications, and final delivery. Such end-to-end participation ensures that design outcomes are not only technically feasible and commercially viable, but also strategically aligned with the client's overarching objectives.

Third, the agencies analysed in this study have cultivated long-term partnerships with major clients. Sustained collaboration facilitates the gradual accumulation of tacit knowledge concerning organisational culture, brand DNA, and market trajectories. This embedded understanding enables agencies to provide design solutions that are both innovative and consistently reflective of corporate identity across multiple product generations, thereby strengthening brand recognition and enhancing customer loyalty.

Fourth, the case study agencies possess demonstrable experience working with OBM-oriented firms as well as small and medium-sized enterprises with limited design expertise and capabilities. Their ability to balance creative exploration with commercial pragmatism allows them to respond effectively to the distinctive challenges of OBM contexts, including

constraints of cost, time-to-market, and manufacturing integration. In doing so, these agencies are able to translate abstract brand values and strategic objectives into tangible design outcomes that simultaneously enhance consumer appeal and business performance.

In conclusion, the design agencies selected for this research exemplify multidisciplinary competence, global execution capability, sustained client partnerships, and contextual experience within OBM industries. These criteria ensure that the agencies under study possess not only the creative and technical expertise required to deliver effective design outcomes, but also the strategic insight necessary to act as long-term partners in brand-led innovation and organisational transformation.

Table 4. 2: Design agency case study descriptions

Criteria	Design agency A	Design agency B	Design agency C	Design agency D
Founding context	Established in California, initially focused on product and engineering design, later pioneer of design thinking and service	London-based, combining product design expertise with strategic and brand insight	London-based blending creativity with engineering rigour, supported by in-house prototyping	Founded in Shanghai, emphasising integration of design into engineering-driven OBM contexts
Core process model	Five stages: Observation → Ideation → Prototyping → Refinement → Implementation	Four stages: Awareness → Visioning of Design → Definition → Action	Three phases: Ideation → Development → Definition, with iterative loops	Seven steps: Insight → Definition → Development → Design → Presentation → Engineering → Integration
Strengths	Human-centred, ethnographic research, structured brainstorming, rapid prototyping, interdisciplinary collaboration	Strong alignment of design with business and brand drivers, participatory workshops, design as organisational learning	Integration of creativity and manufacturability, rapid in-house prototyping, iterative verification	Bridging market insight, technical feasibility, and branding; effective in incremental design integration
Limitations	Iterative ambiguity may clash with efficiency-driven corporate cultures	Engineering-led client structures may constrain integration of design	Resource-intensive, requiring sustained client engagement	Incrementalism may limit radical innovation; complexity may slow decisions
Collaboration with international brands	Catalyst for technology firms; challenged assumptions via deep ethnography	Strategic partner linking design with corporate vision, especially in consumer electronics and mobility	Provided lateral perspectives to corporations, generated patentable solutions	Enhanced usability and brand value in engineering products, e.g., photovoltaic inverter project

Collaboration with OBM firms	Dual role as executor and educator; helped SMEs internalise design via ethnography and prototyping	Assisted OBM firms in building design capabilities during transition, but constrained by engineering dominance	Supported SMEs from start-up to brand identity, including equity participation	Guided Chinese OBM firms to integrate design gradually without disrupting engineering cultures

4.3 Case study results from the international brands

4.3.1 International brand A

4.3.1.1 Design capability and experience

International Brand A is a South Korean multinational corporation that stands today as a globally recognised leader in consumer electronics. Founded in the mid-twentieth century, the firm initially operated within the confines of an OEM & ODM model. Its competitive advantage during this early stage was rooted in its robust manufacturing base and engineering-driven organisational culture. Technological sophistication, efficient production, and economies of scale defined its operations, but these strengths alone proved insufficient in an increasingly saturated and competitive global marketplace.

The decisive moment in the company's evolution occurred in the early 1980s, when it initiated a strategic transformation into an OBM. This move represented not merely a change in business model but also a deep reorientation of corporate strategy. The firm recognised that continued reliance on manufacturing efficiency would not guarantee long-term survival in international markets. Instead, it identified design capability as a missing but critical dimension of its competitiveness.

At the onset of this transition, however, the company's internal design maturity was relatively underdeveloped. Design had not been institutionalised as a core business function, and innovation processes were largely subordinated to engineering concerns. Acknowledging this structural deficiency, the corporation adopted a deliberate approach to capability building. Initially, it relied heavily on collaborations with internationally renowned design consultancies. These partnerships provided access to creative expertise, methodologies such as user-centred design and ethnographic research, and exposure to global best practices. By engaging external

agencies, the company was able to accelerate its learning curve and begin embedding design as a legitimate organisational function.

Over time, International Brand A cultivated its own internal design infrastructure. It established an autonomous in-house design department that evolved from a support function into a strategic unit capable of shaping the company's innovation trajectory. By the late 1990s, its internal design team was fully capable of operating both at the operational level, delivering product design solutions within defined projects, and at the strategic level, where design informed long-term brand positioning, consumer engagement, and corporate vision (Kim, 1997). This process of institutionalising design marked a turning point in the company's organisational narrative, transforming design from an ancillary service into a central pillar of competitiveness and brand differentiation.

The development of design capability within International Brand A illustrates the trajectory of many East Asian corporations: moving from OEM-based manufacturing strength to OBM-led brand competitiveness. The firm's commitment to internal capability building, coupled with early reliance on external design partnerships, created the foundation for design to function as a strategic and operational asset.

4.3.1.2 Design process

To address growing product complexity, rapidly changing consumer needs, and diverse international markets, International Brand A adopted a multi-modal design approach instead of a single standardised process. The company established three interlinked frameworks, the Line-Up Process, Archetype Process, and Advanced Design Process, each aligned with different project timelines, innovation levels, and degrees of design involvement. This structure reflects a sophisticated and context-sensitive model of design management.

(a) Line-Up Process

The Line-Up Process (Figure 4.2) is designed for short-cycle projects completed within a year, focusing on efficiency and responsiveness to market demands such as incremental upgrades or product variations. It follows eight tightly sequenced stages, from planning and design embodiment to prototyping, production, and marketing.

While this process ensures speed and commercial alignment, it limits exploratory creativity. Deep user research, ethnographic studies, and broad ideation are reduced to meet time constraints. External design partners are intentionally excluded to maintain confidentiality and protect proprietary knowledge, but this also narrows perspective diversity and increases the risk of creative stagnation, reducing the potential for breakthrough innovation.

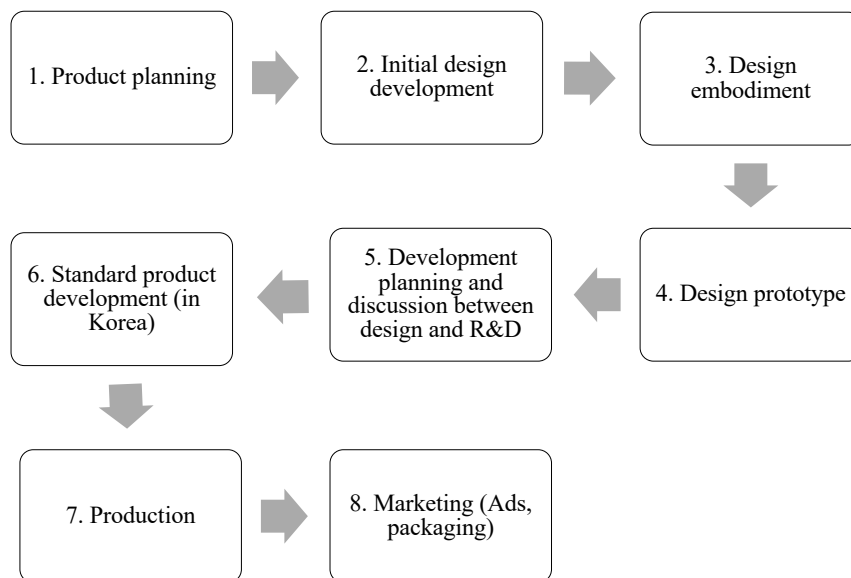


Figure 4. 2: The ‘line-up’ design process of International brand A in the NPD process

(b) Archetype Process

The Archetype Process (Figure 4.3) applies to medium-term projects of up to two years, offering greater strategic scope and design flexibility than the Line-Up Process. It begins with collaboration between the product planning division and the in-house design team, establishing shared ownership of project direction.

A key feature is the integration of comprehensive research, including behavioural analysis, trend mapping, and competitive benchmarking into the early development stages. These activities are directly tied to the company’s innovation agenda, ensuring that consumer insights and market opportunities shape the product brief. Designers take on a strategic role as co-creators of innovation trajectories rather than executors of fixed plans.

The process is iterative, involving multiple cycles of prototyping and stakeholder review to enhance alignment, reduce risk, and secure design integrity before engineering lock-in.

Consistent with Brown (2008) and Kanno & Shibata (2013), early design engagement produces more original and contextually grounded outcomes. As a result, products developed through this process achieve a balanced integration of functionality, emotional appeal, and brand identity.

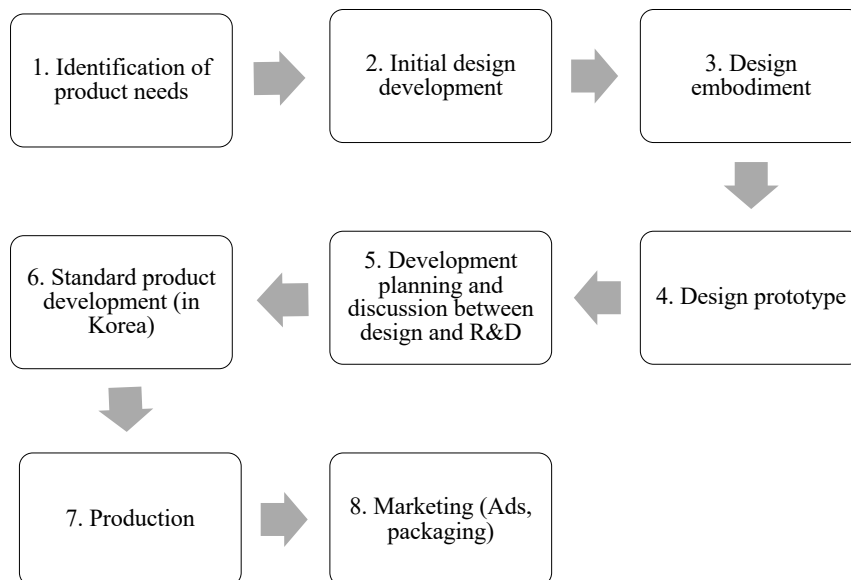


Figure 4. 3: The ‘archetype’ design process of International brand A in the NPD process

(c) Advanced Design Process

The Advanced Design Process (Figure 4.4) focuses on long-term innovation and visionary exploration, typically spanning four to ten years. Initiated by the design team, it emphasises speculative design, technological foresight, and experimentation with emerging paradigms. This process reflects the team’s leadership in identifying disruptive trends, latent user needs, and socio-technological shifts.

Activities include ethnographic research, trend forecasting, conceptual ideation, and cross-disciplinary feasibility studies. Unlike the previous processes, it actively involves external partners, independent studios, universities, think tanks, and futurists to foster cognitive diversity and creative tension. This approach aligns with Verganti’s (2009) design-driven innovation, which highlights redefining product meaning as a foundation for breakthrough innovation.

Beyond generating radical prototypes, the Advanced process contributes to shaping the company’s long-term strategic direction by institutionalising foresight and experimentation.

Through this, the firm challenges conventional assumptions and maintains a future-oriented innovation pipeline. As Jang et al. (2009) note, managing short-, medium-, and long-term processes concurrently reflects a mature innovation system.

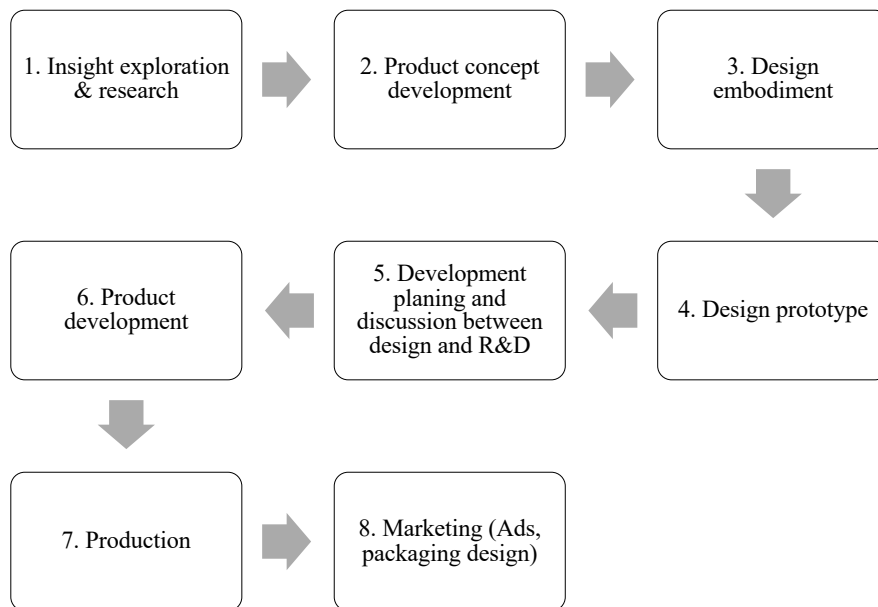


Figure 4. 4: The ‘advanced’ design process of International brand A in the NPD process

The coexistence of the Line-Up, Archetype, and Advanced Design processes illustrates International Brand A’s ability to implement a context-responsive innovation management system. Instead of applying a uniform methodology, the company operates a differentiated portfolio tailored to project scope, time horizon, and strategic intent.

- The Line-Up Process addresses short-term, market-driven demands by compressing development cycles and ensuring operational efficiency, safeguarding revenue and maintaining brand visibility.
- The Archetype Process manages medium-term projects, balancing efficiency and creativity through behavioural research, trend analysis, and iterative prototyping to strengthen brand resonance and consumer loyalty.
- The Advanced Process institutionalises long-term innovation, engaging external networks to generate radical concepts that anticipate future market and technological shifts, mitigating the risks of path dependency and incrementalism.

The strategic strength of this tripartite system lies in its structured differentiation and complementarity. Projects are allocated by scope and strategic priority, allowing short-term execution to coexist with long-term exploration. Knowledge and insights flow across processes, ensuring cross-pollination and portfolio coherence. This integration aligns innovation strategy with operational planning, reducing organisational risk while enhancing efficiency.

This multi-layered framework redefines design as a stratified strategic capability, operational, strategic, and visionary. By embedding flexibility, foresight, and systemic alignment into its design architecture, International Brand A transforms design from a downstream aesthetic function into an upstream, multi-level driver of innovation, differentiation, and sustained market leadership.

4.3.2 International brand B

4.3.2.1 Design capability and experience

International Brand B is one of the most enduring and influential corporations in optics and imaging technology. Founded as a maker of optical glass and microscopes, it expanded into cameras, lenses, and digital imaging systems, achieving global leadership across both consumer and professional markets. Its longevity reflects not only technological resilience but also the institutionalisation of design as a strategic capability within its organisational structure.

The company's design strength lies in its synthesis of craftsmanship and technological innovation. While precision optics established its technical reputation, embedding design within corporate systems enabled sustained competitiveness over successive product generations. This integration of reliability and aesthetic integrity shaped a corporate identity defined by durability, usability, and coherent visual language—qualities that built lasting consumer trust and loyalty worldwide.

Crucially, the company views design not as an aesthetic extension of engineering but as a multi-dimensional capability encompassing usability, ergonomics, manufacturability, and emotional appeal. This holistic perspective reflects a philosophy of systems integration, where design, technology, and market strategy are inseparable. It distinguishes the company from competitors that treat design as a secondary or decorative function.

The firm's adaptability is equally notable. The shift from analogue to digital imaging required technological reinvention alongside a redefinition of user experience and product semantics. The company's design capability ensured continuity of brand identity and user trust through this transformation.

Institutionally, design operates at both functional and strategic levels. Design teams deliver advanced, user-centred products across market segments, while design leadership contributes directly to long-term corporate vision, brand direction, and category development. Design thus functions as both an operational practice and a strategic resource embedded in executive decision-making.

International Brand B exemplifies how systematically cultivated design capability becomes a defining source of global competitiveness. Its century-long trajectory shows that design excellence emerges not from isolated creativity but from the sustained integration of design into organisational identity, technological evolution, and strategic planning. This case underscores design as a durable, institutionalised capability underpinning innovation capacity and enduring brand equity.

4.3.2.2 Design process

The design process at International Brand B represents a hybrid and adaptive system integrating strategic foresight, cross-functional collaboration, and iterative development. While it shares structural similarities with International Brand A's Line-Up Process, Brand B's defining innovation is the establishment of a cross-functional Task Force (T/F) team at the second stage of its NPD process (Figure 4.5). This model exemplifies the company's commitment to collaborative agility, organisational learning, and informed decision-making in complex environments.

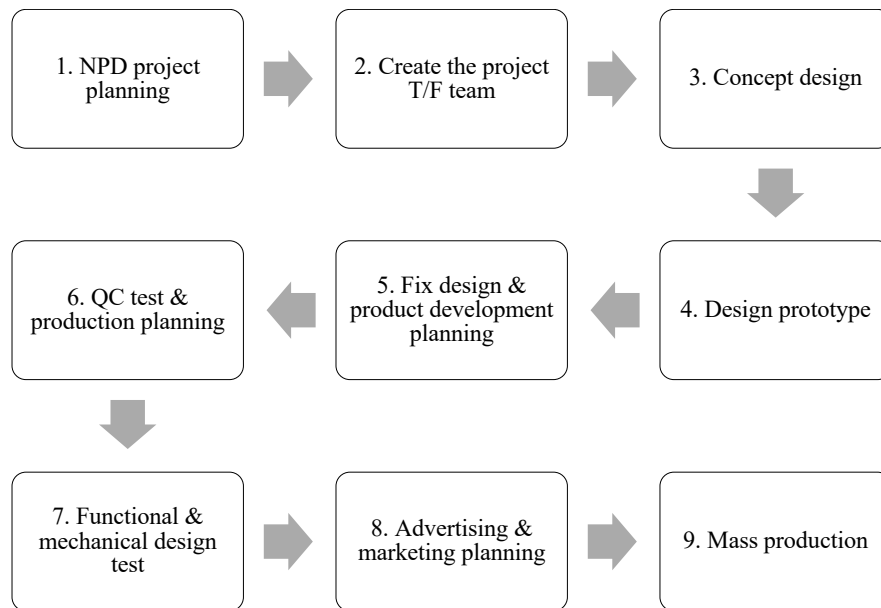


Figure 4. 5: Design process of International brand B in the NPD process

Pre-project planning: Establishing the strategic foundation

International Brand B places strong emphasis on the early phases of NPD, treating the first and second stages as critical pre-project phases rather than preparatory steps. These stages form the strategic base for the entire process, ensuring coherence and reducing downstream inefficiencies. During the first stage, product planning and marketing divisions collect intelligence on user needs, emerging technologies, and market trends, integrating insights from consumer research, R&D, and sales forecasting. The outcome is a detailed project brief that defines market positioning, problem scope, budget, and performance goals. This rigorous approach aligns design intent with commercial viability, reflecting Brown's (2008) human-centred design principle that innovation must balance user empathy and market relevance.

Formation of the cross-functional Task Force (T/F) team

In the second phase, a dedicated Task Force team is formed, comprising members from design, R&D, systems engineering, production, marketing, and quality assurance. Key contributors to the initial brief assume leadership roles, ensuring vision continuity and accountability. The T/F functions as both a coordination hub and a catalyst for organisational learning, enabling rapid, informed responses to evolving challenges. Designers are engaged from the outset not only in creative work but also in feasibility assessment, brand strategy, manufacturing coordination,

and go-to-market planning, affirming Kanno and Shibata's (2013) assertion that cross-functional integration is essential for managing complexity in modern product development.

Concept development and prototyping: Iteration and strategic alignment

Once the T/F is established, designers collaborate with prototyping teams to translate insights into tangible artefacts. Prototypes undergo multiple internal reviews to ensure strategic coherence, technical viability, and user alignment. Concepts failing to meet criteria are refined rather than prematurely advanced, reinforcing the company's belief that design excellence requires disciplined iteration (Holston, 2011). The process reflects systems thinking, balancing form, function, manufacturability, and serviceability to produce outcomes that are both aesthetically and technically robust.

Integration of external design expertise: Embracing openness and creative diversity

To counter insularity and promote continuous creative renewal, International Brand B has begun involving external design consultancies from the earliest planning stages. This collaboration expands the firm's cognitive diversity and exposes it to novel methodologies and aesthetic paradigms. Early-stage partnerships inject experimentation and challenge internal assumptions, aligning with Chesbrough's (2003) concept of open innovation, where internal and external knowledge are leveraged jointly to enhance innovation outcomes.

Strategic and cultural implications

International Brand B's NPD embodies a mature, design-driven innovation paradigm that balances planning, execution, and evaluation while embedding design throughout each phase. The T/F model institutionalises decentralised decision-making and collaborative agility, and the integration of external and internal design resources ensures both operational precision and visionary capacity. Its pre-project strategy highlights that successful innovation begins with problem framing, insight generation, and strategic alignment, rather than with aesthetic ideation alone.

This case demonstrates how design capability can be institutionalised through structural design, process innovation, and cross-functional collaboration. International Brand B's design excellence stems not from isolated creativity but from orchestrated, iterative, and inclusive processes that bridge organisational boundaries. This model offers a compelling blueprint for

firms seeking to transform design from a functional role into a strategic engine of innovation, growth, and long-term competitiveness.

4.3.2.3 Participatory observation

This research is grounded in participatory observation conducted during a six-month collaboration between International Brand B and a UK design agency. For the duration of the project, an in-house designer from International Brand B was seconded to the United Kingdom, commuting daily to the agency's studio and working as an embedded member of the design team. The researcher engaged in and observed weekly project meetings of approximately one hour, totalling fifteen formal sessions across the six-month period, in addition to participating in workshops, informal consultations, site visits, and cross-departmental video conferences with the corporate headquarters.

These encounters unfolded across multiple contexts, including formal meeting rooms, informal discussion spaces, and selected external sites used for market research. Data collection drew upon three interrelated strategies: direct participation in day-to-day design activities, contemporaneous field notes produced during meetings and workshops, and reflective memos composed immediately following key decision-making junctures. This methodological approach privileged lived experience within the design process, enabling close observation of the shifting interplay between organisational actors and the ways in which design rationales emerged, evolved, and were consolidated.

The setting provided access to everyday practices of collaboration rather than relying on retrospective accounts, thereby strengthening the ecological validity of the study. It further allowed for a close reading of how project intentions were operationalised through artefacts, working documents, and collectively endorsed actions. In this respect, the research illuminates not only the tangible outcomes of collaboration but also the tacit dynamics through which design knowledge and strategic decisions were negotiated in situ.

1) Participants in International Brand B's design project

The participant observation revealed that those engaged in the project shared a common perception that “design is not the exclusive domain of a particular group of designers, but an activity coordinated at the organisational level.” This shared recognition shaped the early dynamics of the project, particularly in the planning stage where departments collectively engaged with the fundamental question of “why are we undertaking this activity?” Such questioning was not rhetorical but intended to clarify the overarching project objectives and define the respective responsibilities associated with each stage.

The product planning department assumed responsibility for refining and restructuring the overall process. Its role extended beyond the technical organisation of project tasks to encompass the balancing of specific project aims with the anticipated strategic and market deliverables. The marketing department prepared customer segmentation data and market trend reports, ensuring that the design process was grounded in robust knowledge of consumer expectations and industry shifts. The R&D department explored the applicability of emerging technologies and introduced these possibilities in the early project discussions, thereby broadening the range of potential solutions under consideration.

On the basis of this extensive preparatory material, meetings were conducted with the external design agency in order to obtain expert advice on the design processes deemed most suitable for the project. These sessions were not limited to validating internal perspectives; rather, they became arenas in which external insights challenged entrenched organisational assumptions. The product planning department, in particular, expressed critical reflection on prevailing practices, highlighting that “although products introduced to the market tend to incorporate a wide range of functions, only a limited number of these are actually of practical use.” This statement underscored a paradox: while the company appeared to consistently launch innovative products equipped with abundant features, closer examination revealed shortcomings that neglected genuine user needs.

The decision was taken to involve the external design agency from the outset, with the explicit objective of generating authentic creative solutions and differentiated design ideas prior to the formal commencement of the process. Weekly meetings and collaborative discussions ensured that both internal and external actors were engaged in continuous reflection on how design processes could be aligned with strategic objectives, user experiences, and emerging market demands.

2) Purpose of engaging the external design agency

In addition to the long-term experience and organisational stability offered by its internal designers, International Brand B strategically introduced the creative perspectives of an external agency. This decision was not reactive but reflected a recognition of the limitations of existing approaches. Internal designers themselves acknowledged shortcomings in the previous process, particularly the insufficiency of robust data and the uncertainty inherent in repetitive design practices. Traditionally, the company had tended to design a specific model first and only then explore possibilities for design refinement. However, such an approach had generated consistently weak market responses, exposing the risks of relying on an inward-looking process that underestimated user realities and broader social trends.

Against this backdrop, the external agency was not confined to the role of a mere implementation partner but instead contributed from the earliest stages of the project by introducing user-centred perspectives and stimulating diverse design activities. According to the researcher's observations, these interactions broadened the mindset of the internal team and facilitated organisational learning effects. The presence of an external actor enabled participants to reflect on their own routines, question assumptions about consumer needs, and test the robustness of their knowledge base.

The collaboration was not limited to short-term project outputs but also reflected a deliberate intention to embed new design processes within the organisation in the longer term. The external agency designed a process tailored specifically to the requirements of the initiative, presented this framework to the participants, and systematised techniques for its effective use. The two organisations carefully reviewed the proposed framework prior to project initiation. By grounding subsequent activities in the newly developed process, they anticipated that members would gradually build practical familiarity through iterative learning and practice.

In practice, the external design agency actively supported both training and implementation among International Brand B's project participants. It engaged in continuous dialogue, provided targeted workshops, and created opportunities for experiential engagement with new methods. This positioned the agency not as a peripheral service provider but as a catalyst in the

process of embedding a new design framework. Such contributions extended beyond the conventional parameters of collaboration and can be regarded as fundamental to building long-term organisational capabilities. The collaboration also laid the groundwork for more ambitious outcomes: it opened space for the consideration of innovative and future-oriented business ideas that challenged the established boundaries of the company's product development strategies.

3) Timing of the external design agency's involvement

The external design agency was involved from the pre-project phase, namely during the concept briefing stage. This early engagement was not simply a matter of timing but represented a deliberate strategic choice to introduce an external perspective at the critical stage of problem definition and the setting of strategic direction. As a result, the qualitative standard of initial planning was elevated, with early and systematic attention given to customer perceptions, cultural trends, generational shifts, and subtle contextual signals that internal actors might otherwise have overlooked.

During the pre-project phase, International Brand B provided a briefing on its core challenges under conditions that minimised prior constraints. This openness allowed the external agency to respond with an independent diagnosis and propose alternative scenarios that had not been visible to the internal team. The agency also systematically structured and shared a step-by-step design process tailored to the project. This was not presented as a rigid framework, but as a scaffold to support flexible experimentation and adaptation as the project unfolded.

Internal participants, who had previously adhered to uniform procedures regardless of departmental goals or deliverables, reacted largely positively to the new process. Its introduction revealed alternative approaches that offered greater responsiveness to contextual shifts. This facilitated early alignment around problem-oriented objectives, harmonised expectations across departments, and contributed to reducing the costs of trial-and-error in later phases of the project.

At the same time, the early involvement of the external agency introduced new modes of dialogue. For instance, one participant was recorded as suggesting: "Let us set aside the

constraints we assume for now and reframe the problem beginning with the actual difficulties encountered by users.” This intervention exemplified how discussions could shift from a narrow checklist of functions to a more nuanced engagement with lived user contexts. Such shifts were symptomatic of the value added by early external participation: they created openings for reframing both problems and potential solutions in ways that internal actors alone might not have achieved.

4) Primary roles of the external design agency

The observations indicated that the external design agency performed three principal roles during the project.

First, it assumed a leading function in the design and coordination of the process at a higher structural level. By providing alternative perspectives on the conceptual frameworks produced by the internal team and applying differentiated interpretive lenses, the agency orchestrated the overall trajectory of the project. International Brand B formally designated the external partner as the ‘process owner’ in order to facilitate the long-term internalisation of the framework, entrusting it with responsibility for guiding the project consistently towards agreed objectives. This ensured that the basis of decision-making and accountability was clarified from the outset, and that the project could maintain coherence even amidst competing departmental priorities.

Second, the agency acted as a mediator in broadening the range of perspectives within the organisation. Through its early-stage involvement, it facilitated the reconciliation of diverse departmental views and introduced what participants referred to as an “alternative language” that enabled mutual understanding across professional and disciplinary boundaries. Outputs generated from agreed design activities were reframed as assessment indicators, thereby grounding discussions in collectively validated documentation and procedural outcomes rather than in subjective personal experiences. In this way, the agency played a pivotal role in enhancing interdepartmental coherence and reducing the risk of misalignment.

Third, the agency supported the institutionalisation of process-oriented working methods within an organisational context where such practices had not previously been normative. At the stage of concept visualisation, the agency collaborated with the internal task force to co-develop testable prototypes. These prototypes served as both experimental artefacts and

training tools, enabling members to acquire experiential knowledge through practice. The staged intervention encompassed knowledge transfer, practical exercises, and collaborative engagement until participants themselves recognised the utility of the process. By facilitating this experiential learning cycle, the agency acted as a catalyst for embedding process-oriented design methods into the organisational culture.

The researcher confirmed that these dynamics positioned the external team not as a subcontractor but as a strategic partner, while simultaneously strengthening the standing of the internal task force. Meetings became spaces for sharing progress, reviewing ongoing design activities, and debating which elements should be most fully reflected in the final outcomes. This collaborative process enabled the co-creation of a firm-specific design process that was responsive to the company's strategic requirements. Beyond immediate project outputs, the collaboration created opportunities for exploring innovative and future-oriented business ideas, expanding the horizon of International Brand B's design capabilities.

The analysis of participant observation suggests that International Brand B's design process evolved into a hybrid structure, combining the internal task force with the early-stage involvement of the external agency. This hybrid process mitigated the limitations of closed innovation while simultaneously enhancing openness and organisational learning. Internal participants came to regard design not as a mere instrument of execution but as a central mediator directly connected to organisational strategy. The external collaborator, in turn, operated as a catalyst for creativity and a facilitator of cultural change.

This case thus demonstrates that design capability need not rely solely on the talents of individuals but can be structurally and culturally institutionalised within an organisation. By combining long-term internal experience with the fresh perspectives of external partners, International Brand B succeeded in developing a more adaptive, user-centred, and strategically aligned design process.

4.3.3 International brand C

4.3.3.1 Design capability and experience

Founded in South Korea, International Brand C has grown from a domestic pioneer in consumer electronics into a global technology leader. Its early success in producing household appliances such as radios, televisions, and refrigerators evolved into a diversified business spanning four divisions: Home Entertainment, Mobile Communications, Home Appliances and Air Solutions, and Vehicle Components. This expansion reflects not only industrial growth but also a deliberate strategy to embed design as a central driver of innovation and corporate identity.

From the beginning, the company positioned design as an integral element of its corporate vision and long-term value creation, not as a decorative or surface-level function. Alongside engineering excellence, design became a key instrument for achieving differentiation in global markets (Jang, Lee, Kim & Choi, 2019). This integration fostered a unified innovation culture in which design and technology operate as mutually reinforcing forces within a cohesive value-creation ecosystem.

A defining characteristic of International Brand C's design capability is its dual-track NPD approach. The company simultaneously pursues a customer-following process, which responds to explicit consumer needs and market signals, and a customer-leading process, which anticipates unarticulated desires through the study of emerging cultural and lifestyle trends. This dual orientation balances short-term responsiveness with long-term foresight, preventing short-termism while enabling sustained strategic innovation.

In practice, design and development teams begin projects with comprehensive research into market trends, consumer behaviour, and technological trajectories, grounding creative ideation in analytical insight. This ability to align current realities with future possibilities exemplifies the maturity of the firm's design management capability.

Design is also integrated throughout the entire NPD lifecycle, ensuring continuity from concept to production and launch. Such consistency preserves design intent and maintains harmony among functionality, user experience, and brand identity.

To reinforce design quality, the company has institutionalised evaluation and feedback mechanisms. Internal audits ensure adherence to design principles and corporate identity, while external benchmarking and participation in international design awards validate global

competitiveness. These practices foster continuous improvement and organisational learning, embedding design excellence as an evolving process rather than a one-time achievement.

Furthermore, design is embedded in corporate communication and culture. Through internal showcases, publications, and cross-departmental workshops, the company promotes design's strategic and economic value, cultivating firm-wide awareness of its importance.

International Brand C demonstrates how design can evolve from an operational support function into a strategic organisational capability. Its dual-track NPD model, lifecycle integration, quality assurance systems, and cultural advocacy collectively position design as both a value system and a management methodology. By uniting creativity, technological strength, and strategic foresight, the company sustains global leadership and reinforces long-term market relevance.

4.3.3.2 Design process

The design process of International Brand C (Figure 4.6) represents a deliberate effort to systematise creativity within a large global organisation. Rather than relying on ad hoc or functionally isolated practices, the company has built a structured, multi-layered framework aligning design with technological development, market demands, and long-term strategy. This ensures that design intent consistently translates into differentiated and competitive market outcomes.

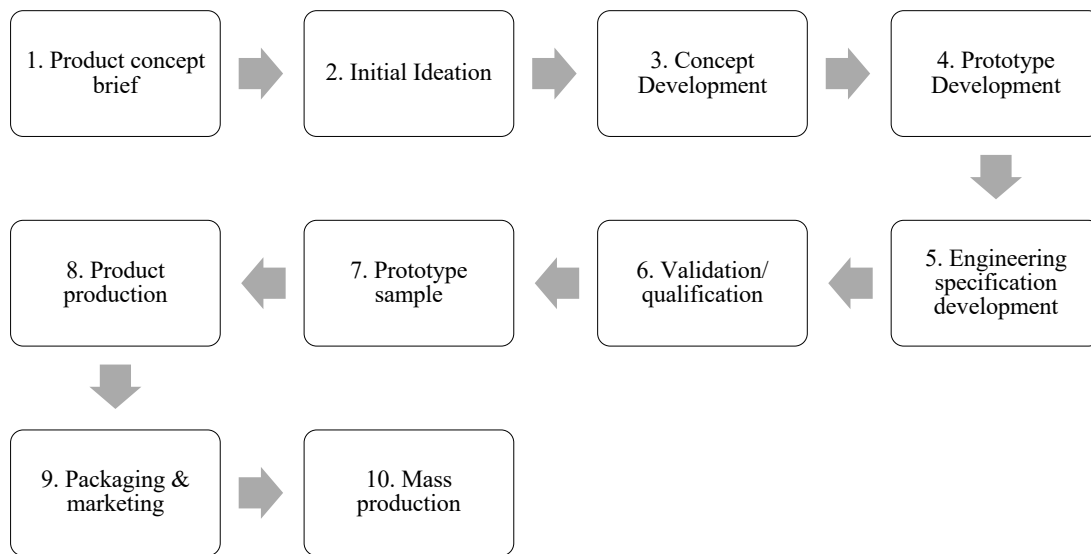


Figure 4. 6: Design process of International brand C in the NPD process

Dual approach to NPD

A core feature of International Brand C's innovation system is its dual-track NPD approach, combining customer-following and customer-leading paradigms. The customer-following process responds to explicit consumer needs through market observation and feedback, while the customer-leading process anticipates unspoken desires by analysing cultural trends, lifestyles, and aspirational behaviours. Together, these approaches balance incremental refinement with disruptive innovation, allowing the company to remain both responsive to present demands and prepared for future shifts.

Both paradigms are embedded at the start of NPD. Cross-functional teams of designers, engineers, and marketers begin with in-depth research into market dynamics, user experiences, and emerging technologies. This analytical grounding ensures that ideas are both market-relevant and strategically forward-looking.

The four-phase NPD framework

International Brand C operationalises this dual strategy through a four-phase NPD model; (1) Creating Product Concepts, (2) Design, (3) Functional Development, and (4) Marketing, each with clearly defined deliverables and responsibilities (Jang, Lee, Kim & Choi, 2019).

- Phase 1: Creating Product Concepts: Ideation is driven by extensive design analysis and market research. Teams identify unmet needs, benchmark competitors, and generate diverse concepts that integrate consumer insights with technological possibilities.
- Phase 2: Design: The design team defines product form, visual identity, and user interface, creating a coherent design language that balances brand ethos and novelty. Collaboration with engineers ensures that usability, materiality, and manufacturability are incorporated early.
- Phase 3: Functional Development: Technical specifications are refined while maintaining design intent. Designers and engineers work in tandem to reconcile innovation with practicality, ensuring outcomes that are feasible, reliable, and emotionally engaging.
- Phase 4: Marketing: Cross-functional teams develop a unified go-to-market strategy. Designers contribute to visual identity, storytelling, and promotional content, ensuring that brand messaging remains consistent with the original design vision.

Design-driven processes and organisational culture

International Brand C treats design as a value system, not a discrete function. Designers remain engaged throughout the entire NPD lifecycle, ensuring continuity between concept, engineering, and market delivery. This end-to-end involvement reinforces the belief that design quality depends on holistic stewardship.

To maintain excellence, the company employs internal and external evaluation systems. Internal audits ensure consistency with brand principles, while external benchmarking and participation in design awards validate global relevance. These mechanisms promote continuous learning and improvement.

Design is also actively advocated and communicated through internal showcases, design publications, and cross-departmental workshops. These initiatives strengthen awareness of

design's strategic role across the organisation, cultivating a culture of collaboration and shared ownership of innovation.

Strategic design integration

The most advanced aspect of Brand C's system is its integration of design into corporate strategy. Designers participate in long-term planning, brand evolution, and business model innovation, allowing the firm to anticipate socio-cultural and technological transformations. Speculative design initiatives, unconstrained by immediate commercial aims, serve as incubators for radical innovation whose insights later inform mainstream projects.

Overall, International Brand C demonstrates a holistic model of design management that integrates creativity, foresight, and operational discipline. Its dual-track NPD strategy structured four-phase process, continuous design engagement, and strong evaluative culture exemplify how design can function as both a strategic and operational capability. By institutionalising design as strategy, the company achieves sustained innovation, global competitiveness, and enduring cultural resonance in the marketplace.

4.3.3.3 Participatory observation

This study is based on participatory observation conducted during a three-month collaboration between International Brand C and a UK design agency. An in-house designer from International Brand C relocated to the United Kingdom for the duration of the project, commuted daily to the agency's studio, and worked alongside the agency team as an embedded collaborator. The researcher participated in and observed weekly project meetings of approximately one hour, amounting to ten formal sessions over roughly three months, and additionally attended workshops, informal discussions, site visits, and cross-departmental video conferences with headquarters. Data were generated through direct participation in routine design activities, contemporaneous field notes taken during meetings and workshops, and reflective memos written immediately after key decision points. The observation therefore privileged lived experience within the design process, captured the evolving interplay between organisational roles, and enabled tracing of design rationales as they developed over time. The setting provided access to everyday collaborative practices rather than retrospective accounts,

which strengthened the ecological validity of the findings and allowed close reading of how intentions were translated into artefacts, documents, and agreed actions.

Collaboration background and aims

The collaboration was initiated to achieve localisation of European home appliance design and to internalise associated expertise within International Brand C. Although the company already maintained a capable in-house design function, it sought to enhance the sensitivity of its design language to European aesthetic and cultural expectations by partnering with a UK agency that possessed deep contextual knowledge. The project began with the merchandise planning office and the marketing team articulating market opportunities, constraints, and commercial targets, which jointly framed the design brief and success criteria. On this basis, structured brainstorming sessions with the agency generated a wide spectrum of early concepts, while clarifying value propositions and the performance envelope expected by headquarters. From the outset, design activity was situated as an extension of product and market strategy, rather than a downstream styling exercise, which positioned aesthetic decisions, technical feasibility, and user value within a single integrated discussion.

Design process and collaboration mode

A defining characteristic of the process was the continuous negotiation between technical constraints and creative intent. Instead of abandoning directions when confronted by limitations, the team pursued problem-solving through close dialogue with the R&D laboratory, tested alternative component architectures, and revisited tolerances, assembly sequences, and serviceability implications where appropriate. This stance preserved the project's differentiation goals and ensured that technical trade-offs were undertaken deliberately, with explicit alignment to user benefit. Collaboration was anchored in small meeting rooms that encouraged frequent, focused exchanges among designers, product planners, and engineers, and was complemented by site visits and targeted industry scans to ground proposals in real use contexts and manufacturing realities.

User-centred design was a consistent thread, with priority given to the felt experience of use, perceived quality, and the emotional register of interaction, rather than to technical novelty alone. To make this orientation concrete, the team convened workshops with younger European consumers. For International Brand C, such participatory formats were relatively unfamiliar at the start of the project, however the dialogues produced actionable insights about expectations

for materiality, affordances, and the visual semantics of control interfaces. Records from these sessions, including anonymised quotes, artefact critiques, and scenario notes, were progressively incorporated into concept evolution, review checklists, and criteria for selecting directions to advance. In effect, user understanding transitioned from a background assumption to a living dataset that shaped day-to-day choices.

Project management and transparency

Project management emphasised transparency and shared context. The agency provided structured weekly briefings that set out current progress, the rationale for decisions taken, evidence supporting concept selection, and the objectives for the upcoming iteration. Each stage documented inputs, intermediate outputs, and anticipated outcomes, which allowed participants from multiple departments to follow the narrative of the work without loss of continuity. This practice reduced coordination friction, increased psychological safety for proposing alternatives, and enabled contributors to exercise autonomy while remaining aligned with the collectively held frame.

Information management practices reinforced this transparency. Working files, sketches, prototype photographs, workshop notes, and meeting minutes were curated so that any participant could describe the project state at short notice. The cumulative record operated not merely as an archive but as a generative resource, since revisiting earlier artefacts often revealed overlooked options or suggested recombinations that led to new insights. In this way, documentation functioned as an instrument for creative leverage, not only as a compliance activity.

Core concepts synthesis

Three core concepts emerge from the observation. First, the deliberate use of an external design agency served as a vehicle for internalising localisation expertise. By embedding an in-house designer within the agency, International Brand C transformed external capability into situated learning, which strengthened its internal capacity for future European programmes. Second, a user-centred approach, with explicit attention to emotional as well as functional experience, consistently guided design choices and proved central to differentiation. The integration of consumer workshop insights into selection criteria and iteration planning illustrates how qualitative data can be operationalised within industrial constraints. Third, transparency in process and information created conditions for disciplined autonomy. Clear narratives of intent,

evidence, and next actions enabled teams to act independently within a shared frame, which improved execution quality and maintained momentum across interdependent workstreams.

4.4 Comparison of international brands

The comparative analysis of International Brands A, B, and C reveals three distinct yet converging trajectories through which design has evolved from a peripheral activity into a core organisational capability (Table 4.3). Although each originates from a different industrial and cultural context, all three demonstrate how design becomes institutionalised as both a strategic and cultural mechanism within advanced manufacturing systems. Together, they provide a coherent framework for understanding design maturity as a process of structural, procedural, and cultural integration.

International Brand A exemplifies a structured yet flexible model of design management, using multiple process frameworks, the Line-Up, Archetype, and Advanced Design Processes to align design activity with market timing and strategic goals. This adaptive structure enables the firm to balance agility and consistency across short- and long-term projects. By tailoring the intensity of collaboration to project type, Brand A sustains responsiveness while maintaining strategic coherence, illustrating an advanced capacity for dynamic process integration.

International Brand B distinguishes itself through pre-emptive collaboration and cross-functional integration. Its early-stage partnership with external design consultancies embeds creative framing directly within strategic planning rather than post-development refinement. The introduction of a Task Force (T/F) system ensures continuity between design, engineering, and marketing, enabling unified decision-making. This hybrid structure combines the procedural precision of engineering with the interpretive agility of design, promoting operational efficiency and conceptual innovation in equal measure.

International Brand C represents the most advanced level of design maturity, where design functions as both a strategic philosophy and an operational discipline. Its dual-track NPD model, Customer-Following and Customer-Leading balances market responsiveness with foresight-driven innovation. The company's emphasis on evaluation, benchmarking, and

advocacy institutionalises reflection and learning, embedding design as a system of continuous improvement and strategic foresight that connects user experience with corporate innovation.

Table 4. 3: Comparative analysis of design processes in International Brands

Analytical Dimension	International Brand A	International Brand B	International Brand C
Process	Three-tier process (<i>Line-up / Archetype / Advanced</i>) applied flexibly according to market and schedule	Early-stage collaborative <i>Task Force</i> with external agency participation	Dual-track NPD (<i>Customer-Following / Customer-Leading</i>) emphasising evaluation and foresight
Level of design integration	Product and project level	Organisational and inter-departmental	Enterprise-wide and strategic
Collaboration mode	Variable intensity and timing of interdepartmental collaboration	Hybrid internal–external collaboration from the outset	Continuous, feedback-driven collaboration
Role of design	Adaptive coordination and strategic responsiveness	Co-creative framing and organisational mediation	Foresight-driven innovation and performance management
Key organisational outcome	Structural flexibility and portfolio adaptability	Early integration and creative agility	Continuous learning and design-led transformation

Collectively, the three cases form a progressive gradient of design integration. Brand A demonstrates adaptive structural flexibility; Brand B highlights the transformative potential of early, cross-disciplinary design participation; and Brand C illustrates the culmination of this evolution, where design transcends functional boundaries to become a strategic and cultural principle guiding innovation and competitiveness.

Overall, the findings confirm that the institutionalisation of design capability is cumulative and reflexive, achieved through iterative learning and organisational adaptation rather than linear progression. Firms that embed design as an organisational philosophy, rather than a functional adjunct, cultivate stronger resilience, creative coherence, and strategic foresight—key attributes for achieving sustainable, design-led competitiveness in global markets.

4.5. Case study results from the design agency

4.5.1 Design agency A

Design Agency A emerged during a period of rapid technological growth that demanded new approaches to product innovation. Initially focused on engineering and product design for technology clients, the firm gained international recognition through interdisciplinary integration, cross-sectoral collaboration, and a culture of iterative prototyping guided by the

principle to “fail early and often.” This philosophy underpinned a series of commercially successful and award-winning projects, securing enduring partnerships with global clients.

As global markets shifted toward service-oriented industries, the agency strategically expanded its scope, from designing physical artefacts to orchestrating holistic experiences across digital and physical touchpoints. This evolution positioned the firm as a pioneer in service design and user-centred innovation, uniting three core dimensions: human needs, technological potential, and business viability.

The agency’s operational model is built on cross-disciplinary collaboration, typically involving teams of three to eight professionals, industrial designers, engineers, psychologists, anthropologists, and strategists led by a facilitator. This structure fosters cognitive diversity and creative synergy, essential for tackling complex, multi-dimensional design challenges.

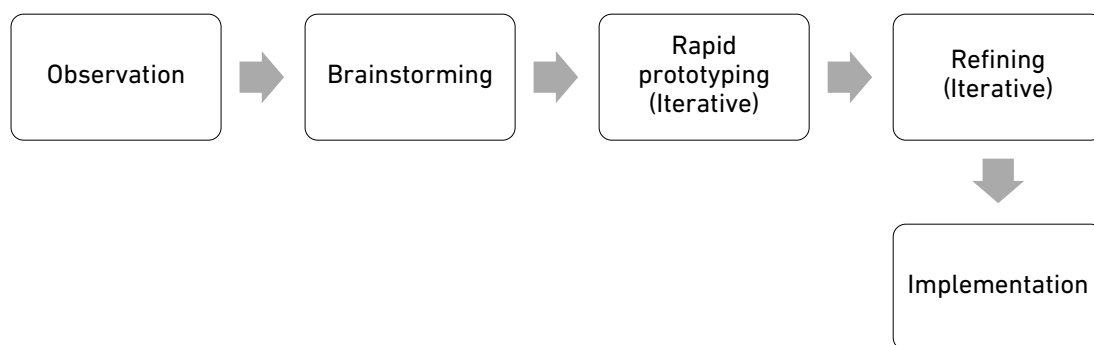


Figure 4. 7: Design process of design agency A

Its five-stage process; Observation, Ideation, Prototyping, Refinement, and Implementation (Figure 4.7), illustrates a methodical yet adaptive approach.

- Observation relies on ethnographic research methods such as shadowing, journey mapping, and camera journaling to uncover latent needs and contextual insights overlooked by conventional research. The use of ‘unfocused groups’ encourages divergent thinking and reveals unarticulated opportunities for innovation.
- Ideation follows structured brainstorming sessions governed by facilitation principles such as deferring judgment, visualising ideas, and building on others’ input. Drawing from cognitive psychology, these rules manage group dynamics and maximise creativity while avoiding groupthink.

- Prototyping transforms ideas into tangible or experiential artefacts, models, scenarios, or service blueprints that invite critique and enable rapid iteration. Concepts are intentionally kept rough to encourage feedback and exploration rather than premature validation.
- Refinement focuses on synthesis and prioritisation, evaluating ideas against desirability, feasibility, and viability. Client executives are actively involved as co-creators, ensuring that outcomes align with strategic and operational objectives.
- Implementation scales refined concepts into production-ready solutions through collaboration among designers, engineers, supply chain specialists, and manufacturers. Long-term partnerships across North America, Europe, and Asia ensure quality and coherence from concept to delivery.

While Design Agency A's methodology is widely respected, its scalability and compatibility with corporate systems remain contested. Critics such as Nussbaum (2011) and Tischler (2009) argue that the exploratory, non-linear nature of design thinking can conflict with efficiency-driven business environments. Firms with rigid hierarchies or process-heavy structures often struggle to accommodate the ambiguity and fluidity that underpin creative problem-solving.

To address this, the agency emphasises collaborative roadmapping, iterative validation, and continuous feedback loops with clients to ensure strategic alignment and organisational integration. Active engagement from senior management and open, cross-functional collaboration are identified as critical success factors.

In essence, Design Agency A exemplifies an advanced, human-centred model of design-driven innovation. Its strength lies in combining deep user insight, structured creativity, rapid prototyping, and interdisciplinary implementation. For OBM firms, it offers a benchmark for embedding design as a strategic capability. However, its effectiveness depends on cultural readiness, managerial support, and tolerance for the uncertain and iterative nature of design. When these conditions align, the agency's model not only enables differentiated product development but also establishes a sustainable framework for continuous innovation and long-term value creation.

4.5.1.1 Design experience with international brands

Design agency A's collaborations with international corporations showcase its ability to act as both an innovation catalyst and a long-term strategic partner. Working with Silicon Valley technology firms in its early years, the agency became embedded in the innovation ecosystem that drove the growth of consumer electronics and computing industries. Its capacity to integrate user research, prototyping, and engineering insight enabled multinational clients to translate complex technologies into user-friendly products.

A hallmark of these collaborations was the agency's emphasis on deep user observation as a foundation for global product strategy. For example, ethnographers and anthropologists conducted immersive studies across different cultural contexts, revealing behavioural patterns that informed product usability and design language. These insights frequently challenged client assumptions and uncovered new opportunity spaces for innovation. Such methods allowed multinational firms to identify unarticulated consumer needs and to anticipate emerging markets, thereby shaping products that resonated across diverse geographies.

The firm also brought distinctive collaborative practices, such as structured ideation workshops and "deep dive" brainstorming sessions, into large organisations that traditionally operated within hierarchical or engineering-driven cultures. By encouraging divergent thinking and prototyping at early stages, Design agency A helped international brands reduce risk while simultaneously pushing creative boundaries. Its insistence on building and testing prototypes whether physical models, service blueprints, or experiential simulations enabled global corporations to make evidence-based design decisions that balanced ambition with feasibility.

The agency's engagements with multinational clients also highlighted the tension between exploratory design processes and efficiency-driven corporate systems such as Six Sigma. While the agency thrived in contexts that valued experimentation and iteration, it encountered challenges when working within rigid operational cultures. Nevertheless, by adopting strategies such as iterative validation, collaborative roadmapping, and sustained communication with senior executives, Design Agency A ensured that its innovations were aligned with corporate priorities and market imperatives.

In this way, the firm demonstrated that even within large corporations, design can serve as a strategic lever for transformation, bridging technology, user needs, and business imperatives to deliver globally competitive outcomes.

4.5.1.2 Design experience with OBM firms

Design agency A's collaborations with OBM firms and smaller enterprises underscore the adaptability of its methodology in contexts where internal design capacity is limited or underdeveloped. Unlike multinational corporations with established design divisions, many OBM firms engaged the agency as their primary external design partner, depending on its expertise to navigate the entire innovation process from initial research through to market delivery. In these engagements, the agency often assumed a dual role: both as a design executor responsible for producing tangible outputs and as a design educator guiding firms through practices unfamiliar to their existing organisational routines.

For OBM firms, the first phase, Observation, proved particularly valuable. By conducting immersive ethnographic studies, such as user shadowing, contextual interviews, and journey mapping, Design agency A uncovered latent user needs and behavioural patterns that smaller companies, constrained by limited resources, were rarely able to identify independently. These insights not only informed product design decisions but also shaped broader brand positioning and strategic planning. For example, ethnographic data sometimes revealed unmet emotional needs or overlooked cultural practices, which enabled firms to reposition products within niche markets or reframe functional attributes as lifestyle-oriented benefits. Such findings provided OBM firms with knowledge that extended beyond immediate design outputs, reinforcing design as a strategic asset rather than a supplementary aesthetic layer.

The agency's prototyping-driven culture was equally transformative for smaller enterprises. By encouraging rapid prototyping and early testing, Design Agency A introduced these firms to a culture where failure was reframed as a constructive and necessary step towards refinement. Prototypes were deliberately kept rough, ranging from foam models to simple role-play scenarios, so that ideas could be tested and critiqued before significant resources were committed. This iterative approach reduced risks, allowed for design flexibility, and significantly increased the likelihood of market success. For firms operating under resource

constraints, the shift towards a prototyping culture was not only cost-effective but also educational, demonstrating the long-term value of iterative exploration.

During the refinement and implementation stages, the agency placed strong emphasis on co-creation with client teams. For OBM firms aspiring to build independent brand identities, this participatory model was critical in enabling internal teams to take ownership of outcomes and gradually internalise design capabilities. Design agency A facilitated organisational learning by introducing practical tools such as service blueprints, customer journey maps, and co-design workshops. These tools provided structured ways for engineers, marketers, and managers to visualise the consumer experience and engage in the design process on equal footing. By embedding such methods into everyday workflows, the agency sought to transform design from a one-time engagement into a repeatable, sustainable process within the client organisation.

Nevertheless, Design agency A also recognised the challenges OBM firms faced when integrating external design expertise. Many firms struggled with the ambiguity and non-linearity of early design stages, finding it difficult to reconcile exploratory methods with their own established approaches to product development. Within OBM companies, product development typically began with clearly defined functional objectives, followed by a sequence of engineering tasks, either sequential or parallel, culminating in the creation of prototypes for functional testing. This linear, function-driven, engineering-oriented process stood in stark contrast to the consumer-centred, iterative, and exploratory logic of Agency A's methodology. As a result, the agency's process was often perceived as unfamiliar, abstract, or even impractical, causing hesitation among OBM firms to fully embrace external collaboration.

To address these tensions, Design Agency A frequently adopted a parallel process approach rather than forcing immediate integration into the client's workflows. This strategy reduced resistance and allowed firms to become gradually familiarised with consumer-centred practices without disrupting their established engineering routines. Unlike collaborations with international corporations, where design methodologies were already institutionalised, working with OBM firms required the agency to demonstrate that its process was not an abstract exercise limited to specialists but one that was directly relevant to the lived experiences of managers, engineers, and end-users. By encouraging active participation, iterative validation checkpoints, and transparent communication of design rationales, the agency helped OBM

firms realise that design activities were not distant or irrelevant, but practices they had encountered in different forms and would continue to apply in future product cycles.

Design agency A's work with OBM firms illustrates both the difficulties and opportunities of external consultancy engagement in engineering-driven environments. On the one hand, the cultural and procedural gap between linear, function-oriented engineering processes and exploratory, consumer-focused design practices created friction and hesitation. On the other hand, by carefully mediating this gap, through parallel processes, co-creation, and iterative validation, the agency contributed not only to successful individual projects but also to the broader institutionalisation of design within these organisations. As such, Design Agency A can be regarded as a benchmark process for how OBM firms may leverage external partnerships to overcome initial resistance, build internal design awareness, and accelerate their transition towards design-led growth.

4.5.2 Design agency B

Design Agency B has evolved into a globally recognised consultancy that integrates creativity with strategic intent to deliver innovation-driven solutions. From its inception, the agency has positioned design as a strategic intervention, a means to enrich customer experience, reinforce brand equity, and drive measurable business growth, rather than as an aesthetic or transactional function.

At the core of its methodology lies the principle of product direction, a structured yet adaptive framework built upon three interdependent pillars: product values, brand values, and business drivers (Figure 4.8). This model clarifies what is being designed, why it is being designed, and toward which strategic objectives. Complementing this is a four-stage design methodology, Awareness, Visioning of Design, Definition, and Action (Figure 4.9) that guides projects from insight discovery to market realisation, ensuring creative exploration remains strategically aligned.

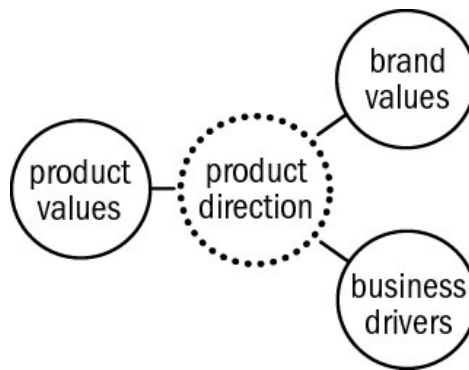


Figure 4. 8: Product direction diagram of design agency B

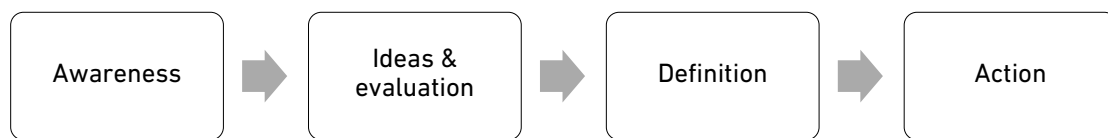


Figure 4. 9: Design process of design agency B

The process balances creativity with systematic evaluation, embedding design within a framework that aligns closely with client objectives and market realities.

- Awareness focuses on deep insight generation, using ethnographic and interpretative methods to uncover latent consumer needs and challenge assumptions. Instead of extrapolating from past behaviour, the agency identifies unarticulated possibilities that redefine opportunity spaces for innovation. These insights form the conceptual foundation for subsequent design stages.
- Visioning of Design translates insights into preliminary directions through brainstorming, sketching, and modelling. Emerging ideas are assessed against brand coherence, user experience potential, visual identity, and market suitability. This stage combines exploration with critical evaluation, producing forward-looking yet strategically grounded concepts.
- Definition refines and prioritises promising ideas into actionable strategies. Through collaborative workshops and co-creation with client teams, the agency ensures alignment with organisational feasibility and leadership vision. Iterative feedback and scenario testing help internal stakeholders take ownership of design outcomes, ensuring effective implementation.

- Action transforms strategy into tangible outcomes. The agency works closely with engineers, logistics teams, and manufacturing partners to preserve design intent through prototyping, testing, and production. Co-location of design teams within client facilities strengthens communication and ensures precision from concept to market delivery.

Through this integrative and iterative process, Design Agency B demonstrates how design can function as a strategic bridge between creativity and business performance. Its model exemplifies how disciplined creativity, anchored in research, collaboration, and strategic foresight can transform design from a project-level activity into a sustained organisational capability for innovation and competitive advantage.

4.5.2.1 Design experience with international brands

Design agency B has collaborated extensively with multinational corporations, where it applies its product direction framework to align design outcomes with broader strategic objectives. Global brands sought the agency's expertise not merely for aesthetic refinement but for its ability to link design decisions with corporate ambition, market positioning, and long-term innovation capacity.

In these contexts, Design agency B's Awareness phase often uncovered user insights that challenged conventional corporate assumptions. By employing ethnographic inquiry rather than standard consumer panels, the agency illuminated unarticulated needs and cultural shifts, particularly in fast-evolving industries such as consumer electronics and mobility. In subsequent phases, these insights were transformed into design strategies that balanced creativity with manufacturability and market feasibility. The agency's international team, comprising designers, engineers, anthropologists, and business analysts enabled it to interpret diverse cultural and technological contexts with precision, providing multinational clients with design solutions that were both iconic and adaptable to global markets.

Through this mode of engagement, Design agency B positioned itself as a strategic design partner to international brands, capable of shaping design directions that not only delivered market differentiation but also reinforced brand narratives across regions. Its work demonstrated that external consultancies could provide critical value even to firms with

substantial in-house design capabilities, by introducing methodologies and perspectives that expand organisational horizons.

4.5.2.2 Design experience with OBM firms

Design Agency B's collaborations with OBM firms reveal both the potential and the constraints of external design partnerships during the transition from ODM to OBM. In one representative case, the OBM firm engaged the agency at a pivotal moment, immediately before formalising its OBM operations to support the internalisation of design capability. With limited prior experience, the firm depended on the agency not only for design execution but also for strategic guidance in building foundational competencies.

From the outset, the OBM firm's leadership displayed a clear ambition to embed design as a core organisational practice, not a superficial styling function. Senior executives actively endorsed design-led transformation, supporting participatory workshops, training programmes, and cross-company creative activities. Design Agency B played a central role in introducing user research, trend analysis, and brand identity systems that addressed both short-term project outcomes and long-term capability building.

However, substantial challenges emerged in aligning design with engineering. In practice, both functions operated in parallel but disconnected, as the agency's independent design outputs were later integrated into pre-existing engineering processes. This limited design's influence on technological development and resulted in products where design followed, rather than shaped, innovation. The lack of a unified process or shared objectives led to weak cross-functional collaboration and limited synergy between design intent and technical execution.

These issues reflected broader organisational constraints. For firms accustomed to engineering-centred ODM cultures, transitioning toward design-led OBM models proved difficult. While collaborations occasionally produced visually compelling or award-winning products, they often failed to achieve full design–engineering integration. Improvements in aesthetics or usability sometimes came at the expense of technical performance, highlighting the tension between creative ambition and operational control.

Despite these limitations, the partnership provided critical learning. Acting as both an educator and strategic catalyst, Design Agency B helped accelerate design awareness and foster internal reflection on innovation processes. The experience underscored that true transformation requires not only external expertise but also cultural and procedural change within the firm. User-centred thinking, iterative methods, and cross-functional integration introduced by external agencies can spark progress but sustaining it demands internal ownership and institutional support.

These collaborations show that while external design partnerships can initiate capability building, the institutionalisation of design within engineering-driven organisations is a gradual process requiring strategic commitment and iterative learning. For OBM firms aiming for global competitiveness, success depends on pairing external collaboration with the long-term cultivation of an internal design culture that embeds creativity, collaboration, and strategic thinking across all levels of the organisation.

4.5.2.3 Participatory observation

Design Agency B maintained a close and strategic partnership with the OBM firm, operating in a top-down manner that facilitated collaboration between leadership and practitioners. By fostering integration across departments, the agency played a central role in guiding the design process, ensuring that creative perspectives were embedded within the organisation's engineering-driven culture.

In the context of a NPD project, Design agency B designers and engineers from the OBM research laboratory engaged in a tightly coordinated process. Over the course of one month, the two parties convened twice weekly in a dedicated meeting space, using three-dimensional modelling as a shared tool for co-developing the external design. In the final stages of design completion, personnel from both organisations worked intensively within the same physical environment, exemplifying a case of concentrated collaboration across disciplinary boundaries.

The project revealed, however, the strong influence of the OBM firm's engineering-centred culture. Historically structured around its research laboratory and engineering teams, the company exhibited a degree of unfamiliarity with design practices, which often translated into

constraints on the agency's influence. In many instances, engineers produced preliminary technical specifications before designers became involved, leaving the latter to adjust the exterior form rather than intervene in the upstream conceptualisation. This cultural dynamic limited the scope of design impact within the organisation.

Collaboration between designers and engineers was also marked by negotiation and compromise. Whereas designers emphasised user-centred features and enhanced usability, engineers frequently foregrounded concerns related to durability, production costs, and schedule adherence. Such tensions required deliberate mediation, as immediate engineering responses to proposed design changes were not always feasible. Consequently, identifying workable compromises became a central aspect of the collaboration.

The broader organisational context further underscored these dynamics. The OBM firm was in the midst of a strategic transition from an ODM supplier to a brand-owning manufacturer, recognising the necessity of sustained investment in both design and technological development. Within this trajectory, the design partnership with Agency B served as both a symbolic and practical step towards embedding brand identity into the company's products.

The design process itself was characterised by focused collaboration and iterative compromise. Through a series of intensive meetings over the span of one month, Agency B succeeded in finalising the product's design and identifying workable trade-offs with the engineering team. Following the conclusion of this design phase, the project progressed into subsequent technical stages, including performance testing and moulding for injection processes.

The outcomes of this collaborative process were notable. The new product demonstrated exceptional refinement in both design and durability, making its debut at international trade fairs. It subsequently gained recognition in global competitions, earning honours such as the Red Dot, iF, and Good Design Awards. These achievements affirmed the value of combining design excellence with engineering rigour in strengthening both market reception and corporate reputation.

Several constraints and difficulties emerged. Maintaining a process dominated by engineering threatened to erode the firm's competitive edge if pursued repeatedly without stronger design integration. The limited synthesis between design and engineering risked escalating costs and

curbing innovation, revealing fundamental tensions in aligning the two disciplines. Consequently, this case emphasised the importance of embedding design more thoroughly into the company's culture, progressing from isolated project applications to a comprehensive organisational approach.

For the OBM firm to secure long-term competitiveness in the global marketplace, it must institutionalise design as part of its organisational culture and establish mechanisms for the repeated execution of integrated design processes. Design agencies, in this respect, play a crucial role not only in delivering project-based outputs but also in raising awareness of the strategic importance of design across the entire organisation. Through sustained partnership, agencies such as B can contribute to the gradual cultural transformation of OBM firms, ensuring that design becomes a core resource for innovation and sustainable growth.

4.5.3 Design agency C

Design Agency C is an industrial design consultancy founded by two designers with complementary backgrounds. Over three decades, it has built a reputation for integrating creative design thinking with engineering precision, maintaining long-term collaborations with both global corporations and smaller enterprises. A distinctive strength lies in its in-house prototyping and workshop facilities in London, enabling rapid physical model production alongside digital design. This infrastructure supports the agency's belief that effective validation requires tangible prototypes, essential for testing ergonomics, usability, and manufacturability rather than visualisation alone.

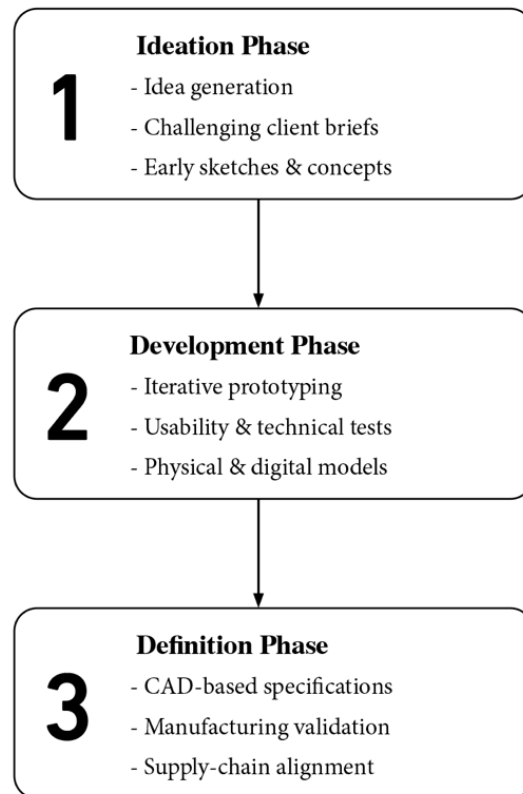


Figure 4. 10: Design process of design agency C

At the core of its practice is a three-phase process; Ideation, Development, and Definition (Figure 4.10), a structured yet flexible framework allowing iterative loops between stages as project demands evolve.

- Ideation focuses on concept generation and exploration. Rather than accepting client briefs at face value, the agency actively questions and reframes them to uncover hidden opportunities. Sketching, scenario planning, and storyboarding are combined with early collaboration among designers, engineers, and model makers to ensure that creative exploration is grounded in technical feasibility and market realities.
- Development translates ideas into tangible forms through iterative prototyping and validation. Using in-house facilities for 3D printing, CNC machining, and model construction, the agency tests design for ergonomics, usability, and technical integrity. Structured co-creation workshops with clients enable feedback and refinement at each stage. The alternating use of digital modelling and physical mock-ups creates a feedback-rich environment that bridges creative ambition and industrial practicality.

- Definition consolidates outcomes into manufacturing-ready specifications, including CAD files, bills of materials, and production documentation. These deliverables account for design intent, supply chain constraints, and regulatory standards, ensuring direct transferability to production.

According to a company representative, the process follows a cycle of “creative divergence, iterative verification, and industrial convergence” (personal communication, 10 August 2021). This flexible structure allows insights from later stages to feed back into earlier ones, enhancing the robustness of final outcomes.

Design Agency C exemplifies the role of external consultancies as end-to-end partners in product development. By challenging briefs, generating concepts, validating prototypes, and delivering manufacturable designs, the agency demonstrates how creativity and engineering can be effectively integrated. Its practice underscores design as both an iterative and evidence-based discipline, bridging innovation and industrial feasibility to deliver commercially viable and user-centred solutions.

4.5.3.1 Design experience with international brands

Design agency C’s collaboration with global corporations demonstrates how an external consultancy can complement and challenge established in-house design divisions. In its partnerships with multinational consumer electronics companies such as Samsung, LG, and Nikon, the agency’s role often began at the ideation stage, where it introduced concepts that extended beyond the narrow scope of initial briefs. Large corporations typically possessed extensive internal design resources, yet they valued Design agency C’s ability to inject lateral perspectives drawn from its exposure to diverse industries and technologies.

For instance, during a smartwatch project for TomTom, Design agency C redefined the interaction model by relocating the antenna and control interface. This adjustment, though modest in form, generated significant ergonomic and functional improvements, ultimately resulting in a patentable solution and providing the client with a competitive advantage in the market. Similarly, by engaging early in projects with international brands, the agency frequently identified opportunities to integrate new materials, alternative technologies, or novel

usability features that internal teams had overlooked. These collaborations illustrate how external agencies, even when working with resource-rich corporations, can play a catalytic role in producing commercially successful innovations.

4.5.3.2 Design experience with OBM firms

While collaborations with large corporations highlight Design agency C's capacity for innovation within complex organisational structures, its work with OBM firms and smaller enterprises underscores a different but equally critical dimension of external design consultancy. Many small and medium-sized firms, often transitioning from OEM or ODM models, lack in-house design capacity and rely heavily on external partners for product development. Design agency C's flexible approach allowed it to assume comprehensive responsibility, from ideation through to manufacturing liaison, particularly in cases where client firms possessed limited design expertise.

One example is its work with start-up clients such as Psion and TomTom, both of which grew from small ventures into globally recognised brands. Design agency C accompanied these firms through their developmental journeys, providing not only design expertise but also strategic guidance on manufacturability, cost structures, and market positioning. This close involvement sometimes extended into royalty-based agreements or equity participation, aligning the agency's incentives with the long-term success of its partners. Moreover, for SMEs, Design agency C's in-house workshop capabilities proved crucial: rapid prototyping enabled early-stage testing and validation that these firms could not have conducted independently.

Such experiences highlight how external agencies can serve as both creative and strategic partners for OBM firms. By filling gaps in design knowledge, supporting technical development, and contributing commercial insight, Design agency C has demonstrated how external collaboration can facilitate the transition from contract manufacturing to brand-owning models, thereby strengthening the competitive positioning of smaller firms in global markets.

4.5.4 Design agency D

Design agency D was founded in Shanghai in 2002 and has since evolved into one of China's most influential industrial design consultancies. From its base in the M50 Creative Park in Shanghai, the firm has expanded its reach across China with offices in Beijing, Shenzhen, Hangzhou, Nanjing, Hefei, Ningbo, Yiwu, and Qingdao, as well as an overseas studio in Florence. Over two decades of operation, the agency has garnered more than 360 international awards, including Red Dot, iF, IDEA, and G-Mark, solidifying its reputation as a pioneer of Chinese design integration in the global arena (Personal communication, November 21, 2019).

Design agency D's mission is to strategically embed design within the business models of its clients, particularly those in transition from OEM/ODM production to OBM identity. Unlike approaches that treat design as an ornamental or peripheral function, the agency positions design as a systemic driver of innovation and competitiveness. This philosophy is articulated in its proprietary model known as "Four Chains Integration, Seven Steps of Innovation", a methodology that aligns market insight, product development, engineering feasibility, and branding communication into a holistic cycle (Personal communication, November 21, 2019).

The agency's design process (Figure 4.11) can be conceptualised as seven interconnected stages: Insight, Definition, Development, Design, Presentation, Engineering, and Integration. Each step builds sequentially to ensure that the outcomes are not only aesthetically appealing but also strategically and technically viable.

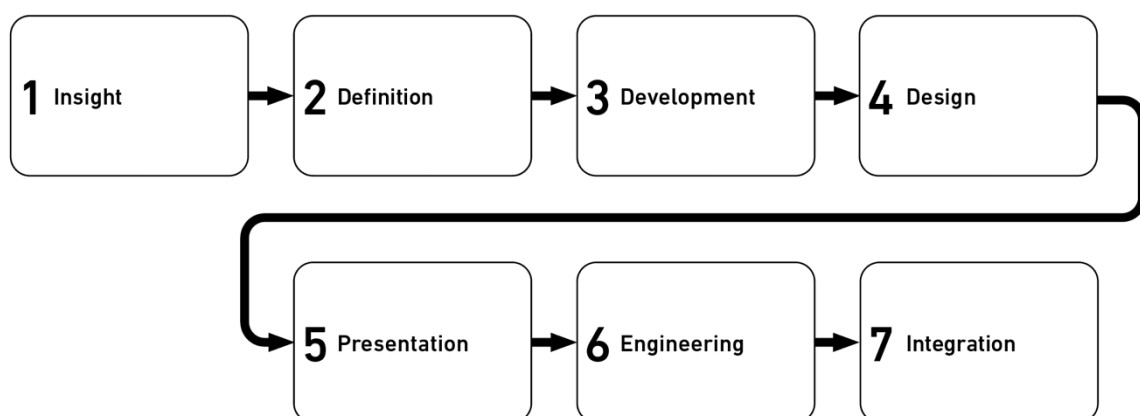


Figure 4. 11: Design process of Design agency D

- Step 1. Insight: Market trends, user behaviours, and brand DNA are deeply analysed to identify latent needs and opportunity spaces.
- Step 2. Definition: Strategic priorities and design goals are established, framing the trajectory of subsequent work.
- Step 3. Development: Concepts are tested against technological and market feasibility.
- Step 4. Design: Industrial design, UI/UX, and branding are executed in parallel.
- Step 5. Presentation: Tangible outputs such as renderings and prototypes are created to facilitate decision-making.
- Step 6. Engineering: Technical integration ensures that design intent is retained in manufacturing.
- Step 7. Integration: Design outcomes are aligned with supply chain, marketing, and brand communication strategies.

This process illustrates that Design agency D operates as a full-service consultancy, bridging the gap between conceptual creativity and commercial realisation.

4.5.4.1 Design experience with OBM firms

Design agency D's collaboration with an OBM client company provides an instructive example of how industrial design can function as a strategic instrument for both product development and brand consolidation. The project centred on the photovoltaic inverter, developed specifically for residential solar systems. Unlike earlier generations of inverters that prioritised functional reliability at the expense of user experience and visual identity, this newly designed inverter was intentionally reconceptualised as both a high-performing energy device and a design-led product capable of representing the company's evolving brand aspirations.

The design brief required that the new inverter series address multiple demands simultaneously: technical efficiency, environmental durability, ease of use, and visual distinctiveness. To achieve this, Design agency D applied a methodology that cautiously integrated design into the engineering-driven culture of the client. The final design delivered a compact and lightweight inverter, markedly smaller and lighter than its predecessors, thereby facilitating easier installation and integration into household energy systems.

A central innovation of the project lay in the engineering refinement of its exterior. As one of the lead designers observed, “One of the most important features of this inverter is the adoption of a die-cast aluminium upper cover. This has significantly improved thermal dissipation and reduced dependence on active cooling systems. In addition, by introducing a fanless structure we were able to minimise maintenance requirements whilst also ensuring long-term reliability in outdoor environments. Moreover, the housing has been certified as both dustproof and waterproof, making it suitable for residential installation under a wide range of climatic conditions.” According to the designer, this was not regarded as a radical breakthrough, but rather as a pragmatic success that demonstrated how technical performance could be reconciled with the gradual integration of design capabilities (Designer, personal communication, 21 November 2019).

Equally significant was the emphasis on user interaction and brand experience. The product incorporated an LCD screen with a simple button-control system, enabling users to navigate settings intuitively without requiring technical expertise. This usability improvement reflected a deliberate shift from viewing the inverter as a purely technical apparatus to positioning it as a consumer-oriented product. As the Red Dot jury noted, the compact and striking appearance of the inverters “breathed new life into an otherwise neutral technical environment,” underscoring how design transformed an engineering product into a brand-signifying artefact (Red Dot Design Award, 2025, para. 3).

The key success of Design agency D in this project was not due to radical innovation but rather to its ability to embrace the client’s engineering processes while gradually and unobtrusively integrating design capability. By respecting the technical culture of the OBM company and introducing design in incremental, non-disruptive ways, the agency achieved outcomes that were both acceptable to engineers and valuable for brand-building. This approach helped overcome organisational resistance and demonstrated that design could be harmonised with engineering priorities rather than perceived as an external imposition.

From a strategic perspective, this project illustrates how design partnerships can accelerate the transition of OBM firms from a functionally oriented manufacturing approach to a differentiated brand identity. By integrating performance, durability, and aesthetic elements, Design Agency D enabled its client to align products with global expectations of quality and innovation. The award of the Red Dot Design Award in 2018 provided external validation,

signalling to domestic and international stakeholders that the company could compete not only on the basis of cost or technical specification but also in terms of design excellence and user experience. However, as one representative of Design Agency D observed, it remains uncertain whether the OBM client will adopt design more actively in the future. While this project demonstrates the benefits of incremental integration of design capability, sustained internal strengthening and the institutionalisation of an optimal design process are far from guaranteed, largely due to the absence of supportive organisational conditions and a sufficiently mature in-house design culture. Consequently, this case suggests that without long-term support from design consultancies, such achievements may prove difficult to maintain. Furthermore, until collaboration with external design agencies becomes a routine practice, substantial time and effort will be required from both process owners and end-users to establish design as a sustainable organisational resource within Chinese OBM firms.

4.6 Comparison of design agency

The comparative analysis of Design Agencies A, B, C, and D reveals distinct yet convergent approaches to integrating design within organisational and market contexts. Each agency's philosophy reflects its geographical origins, methodological orientation, and industry focus, while collectively demonstrating how external consultancies enhance the innovation capacity and competitiveness of OBM firms.

Design Agency A exemplifies a human-centred innovation model grounded in design thinking. Its five-stage process; observation, ideation, prototyping, refinement, and implementation, emphasises ethnographic research, experimentation, and rapid prototyping under the maxim "fail early and often." This method excels at uncovering latent user needs and generating strategic value. However, its iterative and exploratory nature often clashes with hierarchical, efficiency-driven organisations that resist ambiguity and experimentation.

Design Agency B adopts a strategically anchored framework built on product direction, integrating product, brand, and business values. Its four-stage process; Awareness, Visioning, Definition, and Action, combines insight discovery with participatory workshops and co-creation, embedding design as an organisational learning mechanism. In collaborations with South Korean OBM firms, the agency has effectively accelerated design awareness and cultural

change, though deeply rooted engineering-dominant systems often limited full design–engineering integration.

Design Agency C demonstrates a hybrid model balancing creative divergence and engineering convergence. Its three-phase process; ideation, development, and definition, leverages in-house prototyping facilities to validate usability, manufacturability, and technical feasibility. Viewing its process as iterative rather than linear, the agency follows a philosophy of “creative divergence, iterative verification, and industrial convergence.” This dual emphasis on creativity and practicality allows the firm to act as a comprehensive partner, bridging conceptual innovation with industrial implementation.

Design Agency D, operating within China’s rapidly evolving manufacturing landscape, institutionalises design through a systematic, multi-phase integration model called “Four Chains Integration, Seven Steps of Innovation.” Its seven-stage framework; Insight, Definition, Development, Design, Presentation, Engineering, and Integration, connects market research, engineering feasibility, and brand communication. The agency’s culturally sensitive approach, demonstrated in projects like photovoltaic inverters, shows how incremental, design-led interventions can transform engineering-centric firms into design-driven competitors.

Across these four agencies, a shared insight emerges: design attains transformative value when institutionalised as a strategic function rather than an isolated creative act.

- Agency A highlights the importance of ethnographic insight and user empathy, requiring a culture tolerant of iteration.
- Agency B illustrates design’s power as a catalyst for organisational learning and brand transformation under strong leadership.
- Agency C reinforces the necessity of iterative prototyping and manufacturability, bridging creative and technical disciplines.
- Agency D demonstrates that gradual, culturally attuned design integration can overcome organisational resistance and foster sustainable competitiveness.

These cases affirm that design is not merely aesthetic enhancement but a strategic axis linking user insight, organisational culture, engineering feasibility, and brand differentiation. External consultancies, through their adaptive methodologies and cross-sector expertise, play a critical

role in guiding OBM firms through the complex transition from OEM/ODM production models to globally competitive, design-led enterprises.

4.7 Chapter summary

This chapter analysed how design functions both as an internal strategic capability and an external driver of innovation through the comparative study of three multinational corporations (International Brands A, B, and C) and four design consultancies (Agencies A–D). The findings demonstrate that when design is embedded within organisational systems and reinforced through external collaboration, it operates as a dynamic mechanism for learning, knowledge integration, and strategic transformation.

The multinational cases illustrate how firms evolving from OEM or ODM origins have progressively positioned design at the centre of competitiveness. Brand A integrates short-term responsiveness and long-term innovation through its multi-tiered process of Line-Up, Archetype, and Advanced models. Brand B institutionalises cross-functional integration via a Task Force that unites planning, engineering, and marketing from the earliest development stages. Brand C balances incremental and radical innovation through a dual-track NPD model combining customer-following and customer-leading approaches. Collectively, these cases affirm Kanno and Shibata's (2013) argument that aligning design and corporate strategy systematically enhances both product performance and brand equity.

The design agencies reveal how external consultancies bridge creative ideation and industrial implementation. Agency A, driven by human-centred design thinking, employs ethnographic research and rapid prototyping to identify unarticulated user needs, reflecting Verganti's (2009) concept of design-driven innovation. Agency B aligns brand and business values through its Product Direction framework, expanding Bruce and Morris's (1994) perspective on strategic design collaboration. Agency C merges creative exploration with engineering validation through iterative prototyping, offering a hybrid model of design–engineering synthesis. Agency D applies a contextually adaptive approach that embeds design capability within engineering-led organisations, demonstrating how gradual integration fosters sustainable brand differentiation.

Across all seven cases, a consistent insight emerges: design achieves impact through the interplay between internal institutionalisation and external collaboration. Internally, design maturity grows when creative processes are embedded within formal structures. Externally, partnerships with design consultancies accelerate knowledge transfer, challenge routine practices, and strengthen absorptive capacity. This dual mechanism shows that design functions as a connective system that links internal operations and external expertise, facilitating the exchange and accumulation of knowledge that drives innovation.

Design should be understood not as a discrete operational task but as a strategic infrastructure within the NPD system. Whether internally managed or externally supported, design enables firms to balance creativity with efficiency and global consistency with local adaptability. By positioning design at the intersection of business strategy, technology, and user experience, this chapter establishes design as both a catalyst and a product of organisational transformation. These insights lay the conceptual foundation for the subsequent OBM case studies, demonstrating that lasting design capability arises not from isolated creative talent but from the systematic integration of design processes into organisational learning, collaboration, and innovation strategy.

Chapter 5. Design process in OBM firms

5.1 Introduction

OBM represents a strategic inflection point in the evolution of manufacturing enterprises that have advanced beyond OEM and ODM towards the pursuit of autonomous brand building and long-term value creation. This chapter explores how OBM firms develop and internalise design processes as a core organisational capability. In particular, it examines how design contributes to innovation, market identity, and user experience within the context of NPD, analysing these dimensions through structural, procedural, and cultural perspectives. The discussion focuses on understanding how design operates as a strategic asset within the East Asian manufacturing landscape, where engineering efficiency and cost competitiveness have historically dominated industrial practices.

The objectives of this chapter are twofold. First, it examines the constraints and challenges encountered by manufacturing firms transitioning from contract-based production to brand ownership when adopting design management, and analyses how the design process is introduced and utilised within organisations at both strategic and operational levels. Second, it seeks to identify the stages and forms through which design is integrated across the entire product development process, thereby establishing a systematic framework that reflects how design processes operate in real industrial contexts. This analysis draws upon a broad spectrum of OBM case studies across industries such as home appliances, electronics, and robotics, providing a comparative discussion of how the level and characteristics of design maturity differ according to firm size and industrial sector.

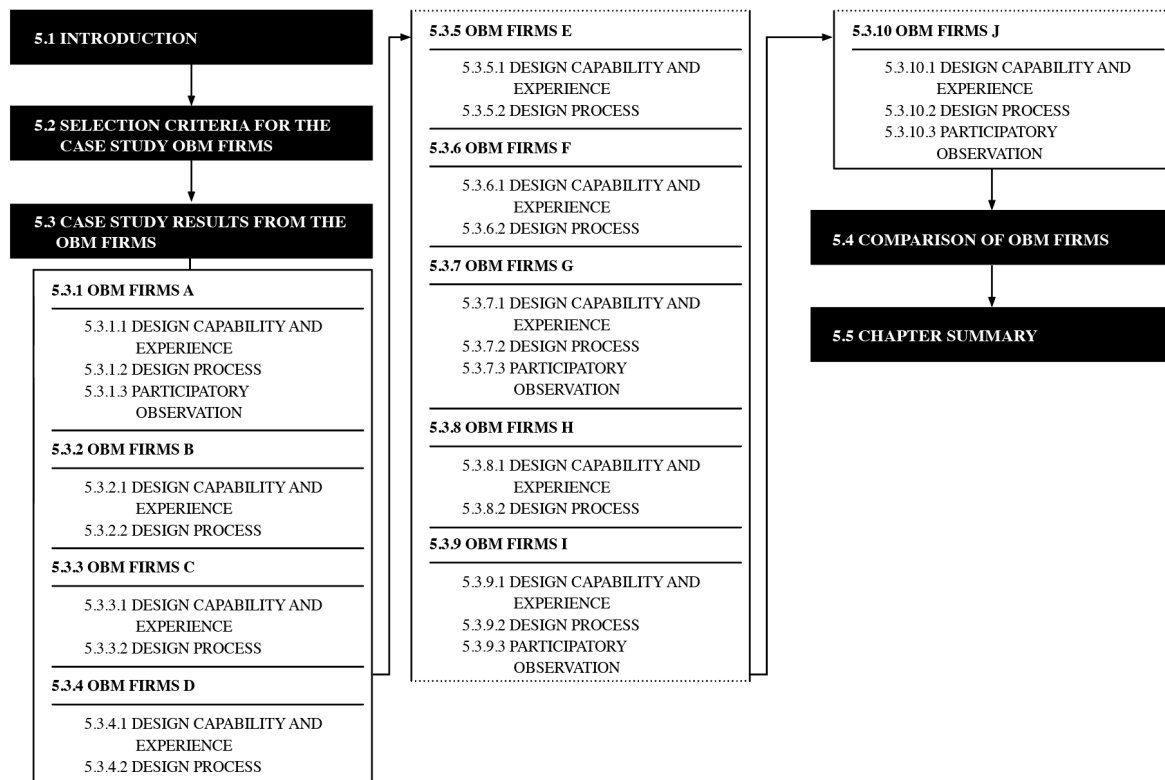
The necessity of this study arises from the observation that many manufacturing-oriented firms, even after transitioning to OBM, continue to adhere to engineering-dominated paradigms, treating design as a supplementary aesthetic stage introduced late in the development process. According to Lee (2006), the shift towards OBM entails not merely a structural change in production but a fundamental paradigm shift towards user-centred and innovation-oriented thinking. Such transformation requires the cultivation of new organisational capabilities, including human-centred design, creative experimentation, and cross-functional collaboration. However, in environments where efficiency and technology-centric cultures prevail, these

capabilities are often difficult to develop. Therefore, this chapter investigates the structural barriers that impede design integration, such as limited budgets, compressed development schedules, and hierarchical decision-making processes, and identifies the organisational conditions necessary for design to exert substantial influence throughout the NPD process.

The empirical discussion is based on diverse OBM firm cases located in South Korea, Mainland China, and the broader Asia-Pacific region. These firms vary widely, ranging from those entirely dependent on external design consultancies to those operating small-scale in-house design teams. Depending on their size and industrial context, the timing of design involvement and the degree of decision-making authority granted to design professionals differ considerably. By comparing and analysing these variations, the chapter seeks to elucidate the positioning of design within firms and the specific stages of product development where it holds practical influence. Furthermore, by linking these empirical insights with existing theoretical discourses on design-led innovation and strategic transformation, the chapter provides a critical understanding of the role of design in shaping the competitive trajectories of OBM firms.

Accordingly, the central aim of this chapter is to systematically examine the current state of design integration within OBM contexts, diagnose the limitations observed in practice, and identify potential opportunities to overcome them. The study demonstrates that design functions not merely as an aesthetic element but as a strategic driver that fosters organisational learning and innovation. Ultimately, it establishes a foundational analytical framework for advancing the design processes of OBM firms and for understanding how design can serve as a catalyst for sustainable competitive advantage.

Figure 5.1 Overview of the overall structure and procedural flow of this chapter.



[Figure 5. 1: Chapter map]

5.2 Selection criteria for the case study OBM firms

The case studies selected for this research (Table 5.1) were strategically chosen to represent a broad spectrum of OBM firms at different stages of design capability maturity and organisational development. The selection aimed to capture variation across industrial sectors, company size, and degrees of design integration, thereby providing a comprehensive understanding of how design functions as an organisational resource within manufacturing firms transitioning from OEM/ODM to OBM.

Each case embodies a distinct strategic and operational configuration of design within its corporate context. Some firms continue to rely heavily on external design consultancies, whereas others exhibit growing internal design capability. Collectively, these cases establish a robust empirical foundation for analysing how OBM firms institutionalise design as a core element of their NPD processes.

The most widely recognised NPD framework in previous research follows the canonical structure proposed by Ulrich and Eppinger (1995), comprising six key stages: planning, concept development, system-level design, detail design, testing and refinement, and production ramp-up (Figure 5.2). This model, together with related frameworks such as Cooper's (1990, 2008) Stage-Gate process and Pahl and Beitz's (1996) engineering design model, provides the foundational theoretical reference for understanding structured product development in manufacturing-oriented firms.



Figure 5. 2: Canonical NPD process model, (Ulrich & Eppinger, 1995)

The following criteria guided the selection of the nine OBM firms:

- 1) Transition from OEM/ODM to OBM: All selected firms have undergone, or are currently undergoing, a transition from subcontracted manufacturing to proprietary brand ownership, ensuring a shared strategic trajectory toward design-led identity building.
- 2) Industrial diversity: The firms represent a range of industries, including consumer electronics, household appliances, audio systems, and robotics, enabling comparative analysis of how sectoral contexts influence design integration.
- 3) Design engagement: Each firm demonstrates an active or emerging engagement with design, whether through in-house teams, external partnerships, or hybrid collaboration models. This ensures that design is a relevant and observable organisational function in every case.
- 4) Variability in design maturity: The firms differ significantly in the maturity of their design systems, from those without internal design staff to those with established design departments, allowing the study to map a developmental continuum across cases.

Table 5. 1: Case study descriptions

Criteria	OBM A	OBM B	OBM C	OBM D
Historical trajectory	Long-standing OEM/ODM supplier for global	Transitioned from OEM/ODM to OBM, expanding	Evolved from OEM to OBM in premium home	Founded as an OEM component producer; grew into

	office automation brands; currently repositioning toward OBM identity through external design collaborations	into self-branded air and water treatment products since the 2010s	appliances, strengthening internal design function since mid-2000s	a global display leader with limited design institutionalisation
Core industry focus	Office automation and printing solutions	Air and water treatment systems	Home appliances (refrigerators, air conditioners)	Display and imaging technology
Role of design	Outsourced to external consultancy; used mainly for product aesthetics and brand differentiation	Supports product innovation and user experience via small internal team	Acts as a strategic function guiding product identity and brand competitiveness	Limited to product styling within engineering-dominant environment
Market strategy	Establishing brand identity beyond OEM dependency	Expanding domestic leadership into global consumer markets	Competing on differentiated design and reliability in premium segment	Targeting technology and B2B markets with innovation emphasis
Design integration model	No in-house design; fully external	Small internal design with external support	Dedicated in-house design team integrated in NPD	Engineering-led with minor design involvement
Significance for OBM research	Illustrates traditional OEM's slow adaptation to design-led strategy	Example of systematic OBM transition supported by design adoption	Demonstrates internalisation of design as a strategic asset	Represents limits of design penetration in large engineering organisations

Criteria	OBM E	OBM F	OBM G	OBM H
Historical trajectory	Moved from OEM/ODM to global OBM in kitchen electronics; combines in-house and external design	Transitioned from OEM/ODM communication supplier to OBM with recent smart technology products	Shifted from OEM/ODM fitness devices to OBM through AI-driven diagnostic technology	Evolved from OEM supplier of audio components to OBM with branded wireless systems
Core industry focus	Kitchen and lifestyle appliances	Communication and surveillance systems	AI-based fitness and healthcare devices	Audio and wireless systems
Role of design	Enhances usability and appeal through hybrid (in-house + external) collaboration	Minimal role; engineering-led product development dominates	Supports interface and experience design via external expertise	Strengthens brand identity and UX through internal design leadership
Market strategy	Enhancing brand reputation via design-led localisation and export	Promoting high-tech engineering with limited brand visibility	Targeting niche global fitness markets through AI and UX innovation	Reinforcing design-led brand competitiveness domestically and globally
Design integration model	Hybrid: internal and agency-based collaboration	No design unit; outsourced entirely	No in-house team; external specialists	Small internal design group supporting NPD

Significance for OBM research	Model of hybrid collaboration between design and production	Shows persistence of technology-led culture hindering design growth	Exemplifies high-tech innovation with limited design maturity	Demonstrates gradual institutionalisation of design in mid-sized firms

Criteria	OBM I	OBM J
Historical trajectory	Founded from university research; progressed from robotics R&D to OBM productisation	Began as an R&D-driven sensor manufacturer in South Korea
Core industry focus	Robotics and automation systems	Precision sensors and environmental measurement systems
Role of design	Integrates design with robotics engineering to improve usability and aesthetics	Evolved from imitation-based to user- and experience-focused; emerging as a strategic function
Market strategy	Developing specialised B2B robotics products with design-oriented branding	Transitioning from component supplier to integrated solution provider
Design integration model	Small in-house and external hybrid design team	Eleven-stage NPD; design joins from E/S-board stage, partially integrated with R&D
Significance for OBM research	Represents design emergence in R&D-intensive robotics context	Represents early design maturity in tech-driven OBM firms; highlights need for institutionalised design integration

Table 5.2 summarises the comparative roles of design and cross-functional teams within the NPD processes of the selected OBM firms. The table highlights the varying degrees of design participation across different development stages, from initial planning and conceptualisation to engineering, production, and marketing. The findings indicate that most OBM firms remain primarily R&D-led, with design functions often positioned as supportive or externally sourced activities rather than as core strategic drivers.

However, a gradual evolution is observed among certain firms, particularly OBM B, C, E, and I, where design involvement extends into the early conceptual stages and collaborates closely

with engineering and marketing units. These hybrid and internally integrated models suggest a growing recognition of design as an organisational competence contributing to innovation, user experience, and brand differentiation. Conversely, firms such as OBM A, D, F, and G continue to display engineering-dominant structures, reflecting the challenges of embedding design within traditional manufacturing hierarchies. Overall, the comparative summary demonstrates that design integration within OBM firms follows a non-linear, context-dependent progression shaped by organisational culture, leadership orientation, and historical development pathways.

Table 5. 2: Summary of design and team involvement in the NPD process of OBM firms

OBM Firm	Planning / Concept stage	Initial design development	Design embodiment & prototyping	Engineering & product development	Design integration level	Team characteristics
OBM A	R&D only	Engineering + External design agency	External agency	R&D-led	Low	No in-house design; strong R&D control, outsourcing dominates
OBM B	Product planning	In-house or external design	In-house/external design	R&D + Design	Mid	Hybrid model with growing internal design team (5 designers)
OBM C	Product planning	In-house or external design	In-house/external design	R&D + In-house design	Mid	Cooperative design/engineering process; early-stage design involvement
OBM D	Product planning or R&D	In-house or external design	In-house/external design	R&D-centric	Mid	Large-scale tech firm; design secondary to engineering priorities
OBM E	R&D, Product planning, Design (joint)	In-house + external design	In-house design	Engineering	Low	Hybrid collaboration; internal design linked with product planning
OBM F	Product planning / Senior Executives	Senior Executives	In-house design/ Engineering	Engineering-dominant	Mid	Internal design introduced but subordinate to engineering
OBM G	Senior Executives	Engineering	Engineering	Engineering	Mid	Executive-driven, minimal design participation, tech-focused
OBM H	Senior Executives	Engineering	Engineering	Engineering	Mid	Gradual in-house design adoption; leadership-driven initiatives
OBM I	Senior Executives	In-house design + Engineering	In-house design/ Engineering	Engineering	Low	Design integrated with robotics engineering; early

5.3 Case study results from the OBM firms

5.3.1 OBM firms A

5.3.1.1 *Design capability and experience*

OBM A, established in South Korea, is a manufacturing enterprise specialising in a diverse range of products including multifunction printers, imaging technologies, and integrated office solutions. For decades, the company operated as an OEM/ODM subcontractor, manufacturing products on behalf of major global brands, particularly those based in Japan and the United States. This subcontracting model allowed OBM A to achieve industrial growth by adhering to the technical specifications and quality standards of global leaders. Over time, this contributed to the development of strong manufacturing capabilities, process discipline, and access to global supply chains. However, the company remained largely invisible to end consumers due to its OEM/ODM position in the value chain, where branding and product strategy were dictated by client firms.

Entering the early 2010s, OBM A encountered a range of external challenges. The global market for printers and office electronics had become saturated, with little room for growth under existing OEM/ODM contracts. At the same time, multinational corporations began consolidating their supplier bases and demanding lower costs, thereby exerting downward pressure on subcontractors like OBM A. The intensifying global competition further exacerbated the company's reliance on price-sensitive contracts, prompting a strategic reassessment. As a result, OBM A began to consider transitioning toward an OBM model. This transition reflected a proactive approach to reclaiming control over product development, branding, and customer relationships. Rather than continuing to rely solely on contract-based production for other companies, the OBM model enabled the firm to capture more value by marketing its own products under its own brand.

To facilitate this transition, OBM A strategically decided to retain its internal R&D functions, which had been a key driver of its technical success, while supplementing its capabilities in design, an area in which the firm lacked experience. To address this gap, OBM A formed a

partnership with a UK-based industrial design consultancy. This decision was grounded in the recognition that competing in the OBM space would require not only technical excellence but also compelling product design that could support brand differentiation and consumer appeal in international markets. The collaboration resulted in the development of a new printer series that gained recognition through prestigious design awards such as the iF Design Award, the Red Dot Award, and the IDEA Award. These accolades not only validated the firm's strategic design investment but also provided third-party credibility as OBM A entered unfamiliar consumer markets. These achievements helped position the company as a legitimate player in the design-driven product category and catalysed internal efforts to establish a long-term design strategy aligned with its new brand identity.

5.3.1.2 Design process

Although OBM A showed early promise in product innovation, its internal structure remained misaligned with the core objectives of design integration. Interviews revealed that its NPD process followed a rigid, linear, engineering-centred sequence (Figure 5.3), spanning from product planning and research to final mass production. The process comprised seven to ten stages, including planning, specification, design, prototyping, testing, and production, supported by intermediary verification steps. Despite procedural rigour, the structure reinforced a traditional engineering paradigm in which functionality, cost, and manufacturability outweighed user experience and aesthetic value.

From the outset, engineering dominated early stages, with design involvement beginning only after critical technical parameters, mechanical layout, materials, and performance targets had been fixed. This left minimal scope for strategic creativity or concept exploration. External design consultancies were typically engaged only after the core product structure had been finalised, confining their role to surface styling or ergonomic adjustments rather than influencing product direction. The result was a reactive rather than proactive design function.

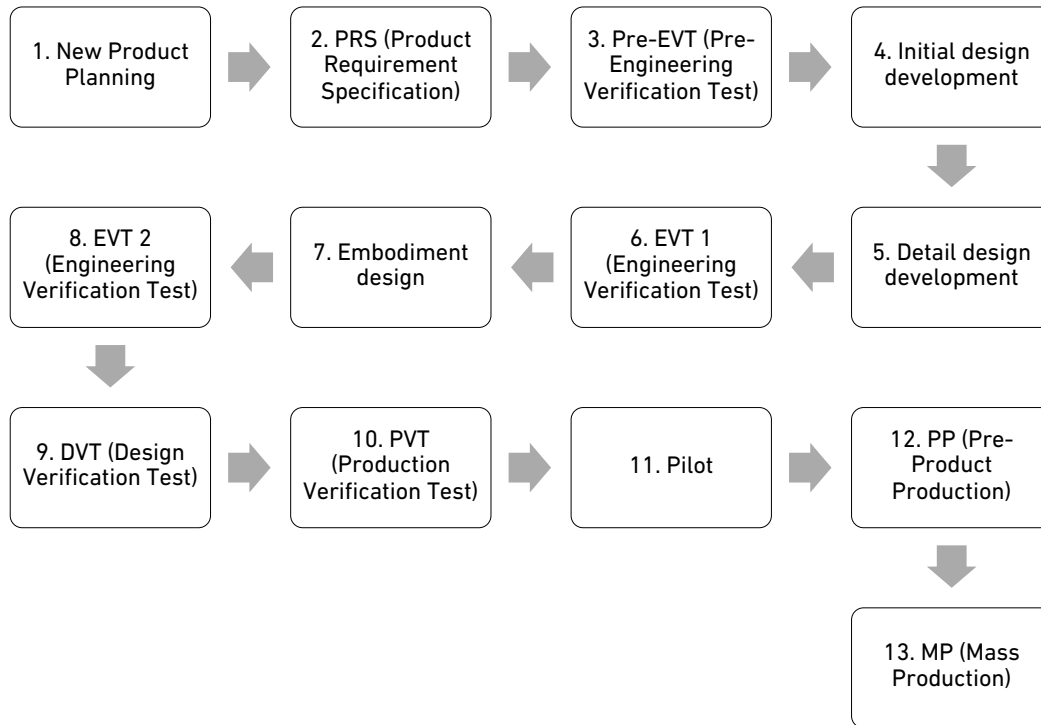


Figure 5. 3: Design process of OBM A in the NPD process

Analysis of internal data identified ten operational stages. In the first, product planning and research, the R&D division conducted feasibility and cost analyses without incorporating user research or design foresight. The next, requirement specification, defined parameters unilaterally through engineering teams, forcing designers to work within pre-set constraints. Early technical validation stages focused on mechanical feasibility but neglected usability or form exploration. Consequently, when external designers entered during the design development phase, opportunities for holistic innovation were already foreclosed.

During detailed design development, designers refined aesthetics and materials, yet communication barriers between design and engineering often caused misinterpretation of visual intent. The absence of a design coordinator further hindered translation between creative and technical languages. Similarly, engineering verification and embodiment phases reinforced sequential logic, with tests (EVT 1, EVT 2) focused solely on technical validation, excluding user feedback. Adopting concurrent prototyping could have allowed mutual learning between disciplines and improved alignment between usability, manufacturability, and brand coherence.

In later phases such as design verification (DVT) and production verification (PVT), design quality was treated as procedural compliance rather than a criterion of value or user satisfaction. Post-production audits were absent, leading to deviations between prototype and final product. Introducing design review checkpoints could institutionalise accountability and preserve brand integrity.

Overall, OBM A's NPD process revealed three key deficiencies:

- Temporal misalignment: design entered too late to influence strategy.
- Structural fragmentation: limited cross-functional collaboration.
- Cultural barriers: weak design literacy and insufficient recognition of design's strategic role.

To progress, OBM A must embed design from the earliest planning stages, establish cross-functional management systems, and foster cultural integration through education and leadership support.

Beyond procedural constraints, organisational and external challenges also limited design institutionalisation. The NPD task force lacked professional design expertise, constraining its ability to evaluate external outputs or implement user-centred methods. Resource limitations further restricted iteration and testing, while pressures for rapid development prioritised efficiency over exploration. Externally, the branding dilemma complicated OBM A's shift toward independent brand development, as long-standing OEM/ODM clients viewed its OBM ambitions with caution.

To mitigate these tensions, OBM A adopted a dual-path strategy: maintaining OEM/ODM partnerships while gradually introducing OBM products into adjacent markets. Leveraging its R&D strengths and flexible infrastructure, it positioned itself as a collaborative innovator rather than a competitor, thereby sustaining revenue streams while building brand capacity.

In conclusion, OBM A's case illustrates the challenges of embedding design within an engineering-dominated organisation. While early collaborations with external consultancies marked progress, long-term competitiveness requires structural reform and cultural transformation. Design must evolve from a decorative adjunct to a core strategic capability,

integrated across planning, execution, and evaluation. Only by reconfiguring organisational systems and leadership orientation can OBM A achieve sustainable, design-led growth and transition from a manufacturing-driven firm to a brand-led innovator.

5.3.1.3 Participatory observation

The researcher participated in this project as a member and design lead of the external design agency contracted by OBM firm A. In this capacity, the researcher was responsible for directing the product's overall design strategy, coordinating design-related communication between the client and the internal engineering teams, and leading the visual and ergonomic development of the final deliverable. The dual position as both participant and observer enabled direct access to internal design–engineering interactions, decision-making procedures, and the dynamics of inter-organisational collaboration. This positionality situates the observation within a moderate participation model (Spradley, 1980), where the researcher is both involved in practical design execution and simultaneously observing the process with analytical intent.

The project was initiated as part of OBM firm A's effort to develop a new product and expand its market presence. The company had previously collaborated with a British design consultancy for strategic design advice and sought to internalise design-driven processes through this initiative. The project commenced in mid-August and was scheduled for completion within 4.5 months, with the objective of exhibiting the new product at the Consumer Electronics Show (CES) in Las Vegas the following January.

The collaborative structure comprised three primary groups: the external design agency (UK), the internal research laboratory (including mechanical and electronic engineering teams), and the executive management team as final decision-makers. While the design agency led the creative and process management aspects, the laboratory retained control over mechanical and functional validation. This dual-track system of concurrent engineering and design development frequently generated friction, as design propositions often conflicted with technical constraints and structural modifications already fixed in the early engineering stage.

The participatory observation was conducted over 4.5 months, from the project kick-off meeting in August through to prototype completion in December. The researcher-maintained observation notes, design review minutes, digital correspondence (emails and chat logs), and photographic records of collaboration sessions and prototype evaluations. Altogether, individual records were compiled, encompassing design iteration meetings, technical adjustment sessions, and workshop discussions.

Weekly on-site collaborative workshops were conducted in the firm's engineering facility, where one to three engineers from the research laboratory and the external designers worked side by side for two weeks of intensive feedback exchange. Real-time modifications were made using two computers connected to shared design software and projected onto a screen for open discussion. These sessions provided valuable insight into communication patterns and problem-solving mechanisms in design-engineering collaboration.

During the early phase, the external design agency carried out market trend analysis, competitor benchmarking, and user needs assessment to establish design concepts. However, because the engineering teams were simultaneously finalising internal design configurations and conducting functionality tests, the integration between design concepts and technical implementation was limited. The first round of design presentations was followed by a narrowing of concepts through internal review, which marked the beginning of the convergence stage of design development.

By mid-November, both the functional and design mock-ups were completed, and a working prototype was finalised in early December. Approximately thirty pilot units were manufactured and shipped before the exhibition deadline. The product achieved high aesthetic and functional quality and subsequently received several international design awards, including the iF Design Award and Red Dot Award.

Nevertheless, this case illustrates the constraints inherent in a research-laboratory-led structure. The external design agency's influence was largely confined to the visual and ergonomic dimensions, while strategic design decisions were dominated by engineering priorities. The design process thus achieved technical excellence within a compressed schedule but lacked opportunities for creative exploration and user-centred innovation. The limited early-stage involvement of design restricted its ability to shape product definition and conceptual framing.

This observation highlights that the absence of a dedicated process management organisation significantly affected the overall efficiency and integration of the project. No single team was responsible for consolidating requirements, managing process alignment, and ensuring iterative feedback loops across design and engineering domains. Instead, each department operated within its own procedural framework, connecting intermittently to exchange data and resolve conflicts. The project's relatively small organisational size enabled this fragmented yet agile structure to function, as teams could convene informally and make rapid decisions. This ad-hoc coordination reflected a trial-and-error approach typical of emerging OBM firms transitioning from engineering-led to design-integrated operations.

From a management perspective, the observation suggests that effective design process implementation requires a centralised process management team endowed with authority over both execution and system-level control. Such a team should possess competencies in process design, workflow management, and cross-departmental communication. Without it, only the CEO or CTO can oversee the process, yet their executive scope limits detailed engagement and process expertise. Ideally, an internal design process management unit would operationalise leadership direction into concrete implementation.

An ideal structure would therefore combine process execution and system administration capabilities within the same organisational entity. While the separation of design, engineering, and project management teams can foster specialised expertise, it inevitably creates communication bottlenecks. Hence, two structural alternatives can be considered: (1) an integrated process management unit when rapid coordination is critical, or (2) a distributed specialist model supported by temporary cross-functional task forces for specific problem-solving contexts.

The participatory observation of OBM firm A's design project demonstrates how concurrent design–engineering workflows can yield both achievements and limitations. The project achieved aesthetic and technical success within a short timeframe, yet it also exposed the challenges of embedding a design-led process within an engineering-dominant organisational structure. The findings emphasise the necessity of early design involvement, integrative collaboration frameworks, and dedicated process management teams for sustainable design capability development in OBM firms.

5.3.2 OBM firms B

5.3.2.1 Design capability and experience

OBM B is a South Korea-based manufacturing and supply company, widely recognised for its expertise in air and water treatment appliances. Its offerings span a broad portfolio of air purifiers, dehumidifiers, and air washers tailored for residential and office use, as well as water-related appliances such as coolers, filtration systems, and purifiers. Established in 1973, OBM B initially built its business through OEM and ODM production for major South Korean conglomerates, most notably Samsung Electronics and LG Electronics. In this capacity, the firm manufactured an extensive range of consumer appliances, accumulating production scale and experience while remaining behind the scenes in the value chain.

In its early years, OBM B developed foundational manufacturing capabilities and industrial know-how through OEM arrangements. These partnerships offered structured opportunities to refine production technologies and align internal operations with the demanding standards of global industry leaders. However, as the company matured, it recognised the limitations of remaining in a subcontracting role. Instead of passively responding to the specifications of client firms, OBM B began building proprietary design, engineering, and branding capabilities to shift toward an OBM model. Importantly, this strategic pivot did not occur in isolation but was enabled through a series of deliberate strategic alliances and global cooperative ventures. These external linkages allowed OBM B to gain access to critical knowledge, specialised expertise, and market insights that would otherwise have remained out of reach.

This shift was also motivated by broader economic trends. As the global manufacturing landscape evolved, the understanding that cost-based competitive advantages are inherently unsustainable, especially in labour-intensive industries, became widely accepted. By the late 1980s, South Korea's export-driven manufacturing model was under pressure, challenged by the rise of low-cost competitors in China and Southeast Asia. In response, OBM B proactively assembled an industrial alliance composed of component suppliers and an external design agency. The goal of this alliance was to facilitate deeper collaboration in product development and to collectively enhance the competitiveness and perceived quality of white goods produced by the participating firms. Through open sharing of core manufacturing techniques, the alliance

was able to accelerate innovation cycles, strengthen the knowledge base of all members, and raise the technological sophistication of domestic home appliance manufacturing.

5.3.2.2 Design process

Figure 5.4 presents OBM B's NPD framework and its associated design process. This process unfolds in 14 distinct and sequential stages. It begins with the creation of a Marketing Requirement Document (MRD), followed by the drafting of a Product Requirement Specification (PRS), and then the initial development of the design concept. Subsequent phases include embodiment design, design finalisation, Pre-Engineering Verification Test (Pre-EVT), prototype development, Engineering Verification Test (EVT), Design Verification Test (DVT), Design for Assembly (DFA), Production Verification Test (PVT), Pre-Production (PP), Mass Production (MP), and finally, packaging and marketing.

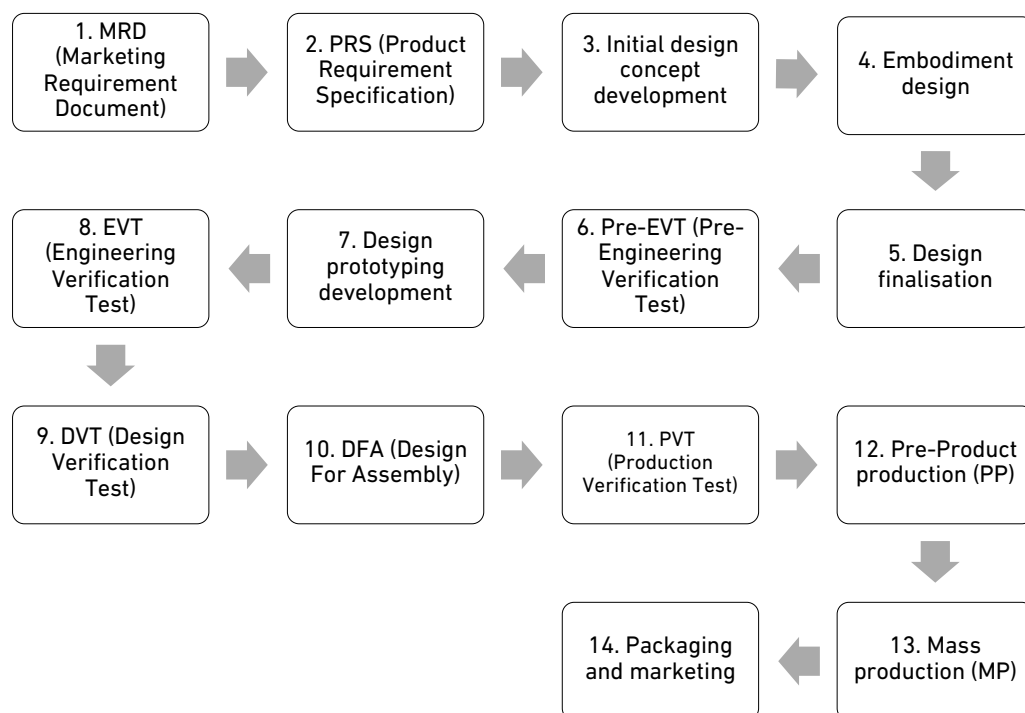


Figure 5. 4: Design process of OBM B in the NPD process

Although this process represents a complete NPD cycle, it maintains a largely linear orientation. Some iterative elements are embedded, especially during prototyping and testing, but these are generally subordinate to the forward-moving sequence. The absence of explicit indicators of scope, duration, or uncertainty in each stage reduces the process' transparency and flexibility.

In practice, this rigid structure may hinder agile responses to user feedback, market dynamics, or design revisions. Thus, despite covering all essential development milestones, the process remains functionally compartmentalised and operationally siloed.

This linearity is emblematic of the manufacturing- and cost-dominant logic that characterises many OBM firms. Emphasis is typically placed on efficiency, scalability, and process predictability. Within this paradigm, design is often marginalised, treated as a post-engineering task focused on styling, interface polishing, or minor ergonomic adjustments. Yet, for firms like OBM B that aspire to build consumer-facing brands and engage directly with markets, this relegation of design undermines their strategic ambitions. For OBM to be successful, design must be repositioned as a foundational business function, capable of influencing product strategy from the outset.

A successful transformation necessitated a comprehensive redesign of OBM B's NPD approach, extending from initial ideation to final product launch. The integration of user-centred design principles and iterative exploration was identified as central to this reform. Such integration required not only technical and procedural adjustments but also an organisational shift toward design literacy, empathy, and interdepartmental collaboration. Embedding design activities in the earliest phases of the development cycle allowed the company to align business goals, user needs, and technical feasibility more coherently.

Internally, OBM B's design department was relatively small, with a core team of approximately three members. To enhance its capabilities, the company maintained close relationships with external design agencies, using these partnerships to fill competency gaps and accelerate design output. This hybrid structure enabled the firm to efficiently transform end-user insights into marketable solutions. However, interviews with stakeholders revealed enduring obstacles. Legacy practices rooted in manufacturing rigidity and linear workflows made it difficult to integrate design into the earliest stages of product planning. While the intent to adopt design as a strategic lever was present, cultural inertia and operational conventions proved difficult to overcome.

Many departments acknowledged the potential of early design involvement in enhancing product-market fit, yet their ability to implement such strategies was limited. Specifically, the lack of established protocols for design integration, combined with underdeveloped internal

design capabilities, meant that many design initiatives were either delayed or deprioritised. Despite broad consensus on the importance of design for brand building and user engagement, actual progress was incremental and inconsistent.

The case of OBM B's journey demonstrates that while production excellence remains a critical foundation, long-term success in OBM markets requires the institutionalisation of design as a central capability. This involves not just adopting new tools and practices but reshaping how the organisation understands, values, and executes design. For OBM B and similar firms, the challenge is not merely technical but systemic: to redefine and redistribute design's role across the full spectrum of product development, from concept to consumer.

5.3.3 OBM firms C

5.3.3.1 Design capability and experience

OBM C is one of South Korea's leading air and white goods manufacturers established during a period of rapid industrialisation. The firm steadily expanded its product portfolio to include cooling systems, refrigerators, dehumidifiers, and other high-efficiency air appliances for residential and commercial use. Initially operating under OEM and ODM-based subcontracting arrangements for both domestic and global corporations, OBM C focused on building technical expertise in thermal and air-related engineering. Its manufacturing-oriented growth strategy was emblematic of South Korea's export-driven industrial model, which encouraged firms to integrate into global supply chains by becoming reliable producers of intermediate or finished goods. Through this model, OBM C succeeded in internalising core competencies related to white goods production and precision cooling technology.

By the late 1980s and early 1990s, as South Korea transitioned toward high-value-added industries and advanced manufacturing sectors, OBM C responded by initiating a gradual shift from OEM production to an OBM structure. This transition was catalysed by the need for brand ownership, market-facing visibility, and product differentiation beyond cost-based competition. In pursuit of this transformation, OBM C began to develop design capabilities internally while also collaborating with academic and professional design institutions. The firm sought to move beyond a purely manufacturing-focused paradigm to create a distinctive design language grounded in consumer experience and emotional engagement. The intention was not merely to

change how the product looked, but to leverage design as a strategic tool to elevate the perceived value of product categories.

In its effort to reposition its brand, particularly within premium product segments such as refrigerators and air purifiers, OBM C adopted a design-driven strategy centred on enhancing visual sophistication, improving user interface intuitiveness, and refining its Colour, Material, and Finish (CMF) principles. This approach was aimed at shifting consumer perceptions and positioning the brand as a premium and trustworthy choice. Importantly, this was not a cosmetic exercise but a deliberate attempt to elevate the user's product interaction and turn functionality into brand experience. In short, OBM C recognised design not just as a creative function but as a vector of experiential and symbolic value that could redefine customer expectations and brand equity.

However, transitioning from an OEM to an OBM model entails substantial organisational, financial, and strategic risks. OBM C experienced numerous challenges and iterations during this transition. Internally, the integration of design as a strategic function met resistance rooted in entrenched organisational culture and limited practical understanding among non-design departments. The company's engineering- and R&D-dominated workflow remained structured around top-down development models, which restricted the early-stage involvement of designers in product ideation and strategic planning.

5.3.3.2 Design process

Figure 5.5 illustrates OBM C's NPD process, comprising 14 sequential stages: from product planning, initial design concept development, design refinement, and final design development, to Pre-Engineering Verification Test (Pre-EVT), prototyping, Engineering Verification Test (EVT), Design Verification Test (DVT), Design for Assembly (DFA), Design for Manufacturing (DFM), Production Verification Test (PVT), pre-production, mass production, and finally, marketing.

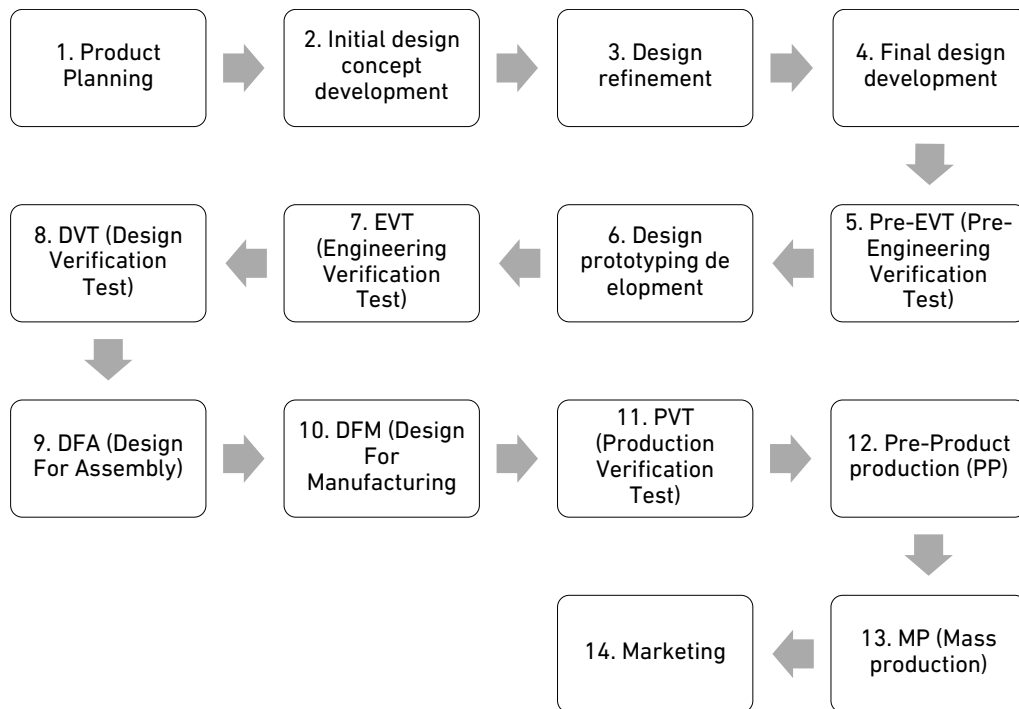


Figure 5. 5: Design process of OBM C in the NPD process

Design activities are primarily concentrated in four of these stages, and the process is constructed in a practical and efficiency-driven manner. According to internal interviewees, this approach stems from a fundamental constraint in manufacturing: any design change late in the process directly correlates with increased cost and delays. This industrial logic has pushed the design function into a reactive role. As a result, the initiation of the design process typically occurs only after initial engineering specifications have been validated, leading to a backward integration of design activities within the overall workflow.

The internal design team, composed of approximately 15 members, is responsible for form development, concept creation, and consumer research, while also functioning as an operational bridge between R&D and manufacturing departments. However, stakeholders have indicated that the design team is often treated as a supporting unit for the engineering division, rather than an autonomous strategic actor. The team's involvement typically begins at the prototyping phase, where it visualises technical feasibility and reflects user feedback into product development. While this role is critical, it remains limited to refining product appearance and usability rather than initiating conceptual innovation or redefining the product's core essence.

Despite the firm's aspirations, design's strategic impact remains circumscribed by legacy processes. The integration of design into early-stage planning, cross-functional ideation, or upstream innovation remains minimal. Consequently, although OBM C's design initiatives have moved beyond mere styling, their strategic positioning within the organisation remains relatively weak. Achieving a transformative impact will require not only an expansion of design competencies but also a systematic realignment of development workflows, strategic tool, and organisational mindset.

While the OBM C has taken tangible steps to position design as a value-creating discipline, full realisation of its potential will depend on overcoming internal resistance and restructuring design management and planning. Systematic integration of design across strategy, organisation, and production systems will be essential. In particular, design's ability to visualise advanced technologies and articulate brand meaning will be a determining factor in the sustainable competitiveness of both products and corporate identity.

5.3.4 OBM firms D

5.3.4.1 Design capability and experience

OBM D is a leading manufacturer that has played a significant role in the development and supply of advanced display technologies. Its core expertise lies in flat panel displays (FPDs) and thin-film transistor liquid crystal displays (TFT-LCDs). Initially, the company functioned primarily as an OEM subcontractor, supplying computer display components to major Japanese electronics firms including Nissin, Tanshi, Asahi, Marubeni, and Kyoei Shoji. This early business model enabled OBM D to acquire deep technical proficiency in high-precision display manufacturing, especially within key product categories such as computer monitors, vacuum fluorescent displays (VFDs), and super-twisted nematic LCDs (STN-LCDs).

By 1998, OBM D had recognised the structural limitations of the OEM model and the diminishing long-term value it could offer. Consequently, the company began to pursue an OBM strategy. This shift involved significant organisational realignment and investment in brand-building capabilities. OBM D strategically expanded its portfolio through global acquisitions, including the TFT-LCD division of a major Korean electronics firm, and moved

into mobile LCD applications, seeking to diversify its revenue base and enter higher value-added markets.

In 2012, OBM D made its first concerted effort to integrate industrial design into its product development by collaborating with a UK-based design consultancy. This partnership aimed to develop 55-inch SNB and 65-inch UHD LCD television models under the company's own brand identity. The strategic intent was to craft a compelling visual identity that could clearly communicate OBM D's technological excellence and establish product differentiation in an increasingly saturated global home electronics market. However, the absence of prior experience in managing branded product development and the firm's limited internal design expertise led to disappointing outcomes. Stakeholder feedback revealed that the final product design lacked coherence, failing to reflect the intended level of innovation and aesthetic distinction.

This initial failure served as an inflection point, prompting OBM D to reflect critically on the role of design within its organisational structure. Recognising design as a potential catalyst for innovation, the company shifted its approach. In 2014, OBM D engaged a U.S.-based design consultancy to conceptualise a new line of products that would visually articulate the firm's technological sophistication and future-oriented brand vision. This engagement produced a significantly improved outcome, with positive market reception and internal acknowledgment of design's strategic value. It was at this point that OBM D began to frame design not merely as a stylistic embellishment but as an integrative resource capable of influencing product development, brand storytelling, and market positioning.

5.3.4.2 Design process

Figure 5.6 illustrates the current NPD framework at OBM D, consisting of nine distinct stages: (1) Product planning and research; (2) Mechanical engineering design; (3) Specification definition for LED and panel components; (4) Industrial design (in collaboration with external design agencies); (5) Comprehensive evaluation and functional testing; (6) Tooling development by OEM suppliers; (7) Parts assembly; (8) Evaluation and refinement; and (9) Full-scale production.

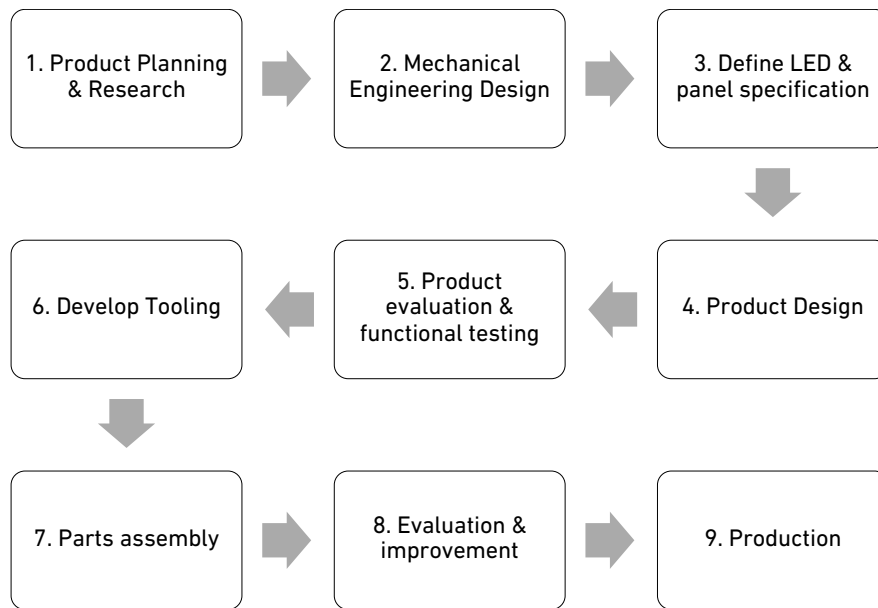


Figure 5. 6: Design process of OBM D during the NPD process

This NPD process is methodically segmented and efficiency oriented. Each stage is functionally siloed, and responsibilities are clearly distributed across engineering, supplier, and design functions. Notably, industrial design is introduced at the fourth stage, where it plays a central role in defining visual language, user interaction principles, and the translation of technical specifications into consumer-oriented aesthetics. However, the relatively late introduction of design in the workflow indicates its auxiliary status within the overall development hierarchy. While the engineering team defines functional metrics and material specifications in the early stages, design's influence is often constrained to visualisation tasks rather than strategic ideation or system-level innovation.

Despite these limitations, the integration of external design agencies has enabled OBM D to address capability gaps and experiment with diverse aesthetic frameworks. Design has gradually evolved into a vehicle for emotional engagement and brand recognition, helping the company move from being a contract manufacturer to a value-driven brand. Yet, several structural issues remain. Interviews with internal stakeholders suggest that the firm's reliance on external design services has impeded the cultivation of internal design thinking and cross-functional collaboration. As a result, design continues to be treated as a post-specification activity, disconnected from upstream processes such as concept development and strategic planning.

Moreover, the lack of a unified management framework for design means that its impact is uneven and often circumstantial. While OBM D has the financial resources and technical workforce to support design-led transformation, its progress has been constrained by organisational inertia and a fragmented approach to design integration. Without consistent leadership, cross-departmental communication, and a long-term design vision, the role of design remains reactive rather than transformative.

The company has taken significant steps to externalise design capabilities and inject aesthetic value into its offerings, but sustainable innovation will require a deeper internalisation of design principles. Future progress depends on establishing a design process management that integrates design across all phases of product development, from initial ideation through to production and market release. Only through such systemic integration can OBM D realise the full strategic potential of design and secure long-term competitiveness in premium global markets.

5.3.5 OBM firms E

5.3.5.1 Design capability and experience

OBM E established by a group of former researchers from the international corporate research institute, has grown into a specialised manufacturer in the field of optometric medical devices, focusing on international markets. The firm has developed a wide array of ophthalmic equipment, including Auto Refractometers/Keratometers, Automatic Lensmeters, and Automated Visual Acuity Testers, primarily through its proprietary technological capabilities. The company's strategic orientation is built upon combining precise engineering with medically compliant product standards, emphasising both innovation and clinical functionality.

The in-house design team comprises four professionals, two industrial designers and two graphical user interface (GUI) designers. These teams play a core role throughout the full product development lifecycle. Notably, industrial designers at OBM E are embedded from the inception of a project through to its production, necessitating an interdisciplinary skill set that merges visual creativity with technological fluency. Their role extends beyond conventional styling and encompasses a hybridised understanding of visual aesthetics, engineering, problem-solving, and manufacturing feasibility.

5.3.5.2 Design process

Figure 5.7 outlines OBM E's product development process, which consists of nine sequential stages: (1) KPI (Key Performance Indicator) Meeting; (2) Engineering Verification Test (EVT); (3) Initial Design Concept Development; (4) Design Refinement; (5) Design Verification Test (DVT); (6) Design Finalisation; (7) Production Verification Test (PVT); (8) Pre-Production (PP); (9) Mass Production.

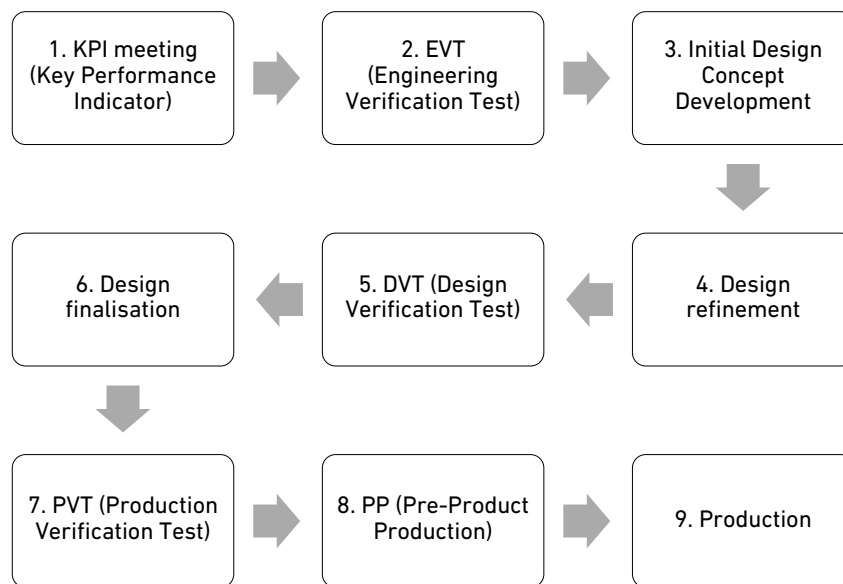


Figure 5. 7: Design process of OBM E in the NPD process

The distinctive feature of OBM E's NPD process is its inception through a KPI meeting, led jointly by the R&D and marketing departments. This meeting is strategically designed to assess, quantify, and align new product objectives with measurable value indicators. During the KPI meeting, stakeholders determine critical factors such as target product specifications, design and manufacturing timelines, personnel assignments, cost estimation, lead times, and projected profitability in relation to competitors. This phase provides a structured framework that manages every subsequent stage.

Each stage within the NPD framework must fulfil clearly defined requirements to proceed to the next. These requirements are categorised into three classes: functional requirements, non-functional requirements, and production-oriented non-functional requirements. Functional requirements encompass core operational criteria that a product must satisfy to be considered

technically viable. Initial mechanical design and functional prototyping are developed at this stage to verify component-level functionality.

Non-functional requirements refer to aspects of form, usability, and the aesthetic identity of the product. These include decisions about shape, materials, colours, finishes, and the user interface. The collaborative work of engineers and designers is essential here to balance structural feasibility with ergonomic and experiential value. Design language, branding consistency, and intuitive operation are emphasised to ensure product-market fit.

The third category, production-based non-functional requirements, is focused on manufacturing efficiency and defect reduction. Products that are difficult to assemble or contain overly complex structures risk increasing operator fatigue and lowering production efficiency. This can lead to higher defect rates, elevated production costs, and extended lead times. Accordingly, the refinement of design at this stage is directly correlated to overall productivity.

During the EVT stage, the engineering team constructs prototype mechanisms that are functionally representative but may not reflect the final product's physical design. The goal here is to rigorously evaluate whether the device meets its functional requirements under standard and stress-tested conditions. Given the relatively low production volumes associated with medical devices, OBM E faces structural challenges such as difficulty meeting cost-efficiency benchmarks, pressure to reduce design expenditures, and constraints in achieving scalable manufacturing economics. These limitations make the efficiency and accuracy of design-engineering alignment even more critical.

Stages three and four, Initial Design Concept Development and Design Refinement, are led primarily by the in-house designers. At this point, designers are responsible not only for creative conceptualisation but also for ensuring the product design supports the unique value propositions of the firm. After conceptual sketches and models are created, designers iterate in tandem with engineers to test mechanical integration and user interaction scenarios. It is at this phase that the design team begins to transition into an engineering support role, helping to visually communicate the product architecture while ensuring the solution meets functional, ergonomic, and visual standards.

Unlike firms where design is strictly aesthetic, OBM E positions its industrial designers as integral contributors to both hardware and systems design. While creativity is preserved, it is constantly informed by engineering constraints, clinical regulations, and technical feasibility. This collaborative dynamic enables the team to converge on technically sound and user-friendly solutions. However, as mapped against the Danish Design Ladder (see Figure 12), OBM E's design maturity may still be categorised within the lower rungs, namely Levels 1 (Design as Styling) or 2 (Design as Process), as design remains secondary to engineering leadership in strategic decision-making.

In the DVT phase, all functional hardware components are assembled in near-final configuration. The team then ensures that all system requirements, originally established during the KPI stage, have been satisfied. Upon successful completion, the process advances to PVT, where a pilot production line is initiated to test scalability, detect potential faults, and refine production flow. If design modifications are necessary due to ergonomic or technical shortcomings, internal designers may re-engage, although external design input is typically excluded unless substantial visual redesign is warranted.

To conclude, OBM E exemplifies a technically competent yet engineering-centred approach to product development within a specialised industrial field. The integration of in-house designers into the engineering workflow reflects an advanced but still limited form of design-led innovation. While the firm has made meaningful progress in bridging design and engineering functions, further advancement will require stronger leadership commitment, deeper strategic alignment, and an organisational culture that recognises design as a transformative, not merely supportive, capability. Only through this cultural and structural evolution can OBM E fully leverage design to elevate product quality, enhance user experience, and strengthen brand perception in the global medical-device market.

More broadly, the OBM E case illustrates a recurring pattern among emerging OBM firms in technology-intensive industries: the necessity of shifting from functionally segmented design practices toward integrated, cross-disciplinary collaboration. Although the firm's KPI-driven planning structure provides operational discipline, its strategic potential remains constrained without embedding design participation early in the development process. To evolve from a reactive service provider into a proactive co-creator, OBM E must institutionalise design metrics aligned with corporate objectives, formalise iterative feedback mechanisms, and

cultivate design literacy across technical teams. Ultimately, its global competitiveness will depend on combining technological excellence with user-centred design, achieving seamless integration from concept to commercialisation.

5.3.6 OBM firms F

5.3.6.1 Design capability and experience

OBM F began its operations as a manufacturer and supplier of industrial portable wireless communication devices. In its formative years, the company co-developed mission-critical communication equipment through ODM partnerships with globally recognised telecommunications firms such as Ericsson and GE. These collaborations involved the development of TRS terminals, video monitoring systems, two-way radios, handheld portable terminals, mobile radio systems, and navigation devices. Such partnerships enabled OBM F to internalise high-precision digital communication technologies and establish a manufacturing system based on high-mix, low-volume production.

The firm's primary client base included professional entities operating in high-risk and regulated environments, construction sites, high-security zones, ports, airports, police departments, military installations, and emergency response teams. As a result, product development was narrowly focused on durability, reliability, and technical performance. Industrial designers were absent within the organisational structure, and the product design process was managed entirely by engineering teams and executive management. Consequently, design remained a secondary concern, largely defined by functional necessity rather than user experience or market positioning.

In 2016, OBM F underwent a strategic shift to diversify its portfolio by launching its own branded motorcycle and powersports Bluetooth communication systems. This new product line incorporated dual Bluetooth modules using Bluetooth 4.0 technology, offering significant advancements in wireless connectivity, high-definition audio transmission, and operational reliability. This initiative marked the company's first attempt at establishing a consumer-facing brand. However, due to a lack of internal design capabilities, OBM F outsourced the product's external design to a local design consultancy.

5.3.6.2 Design process

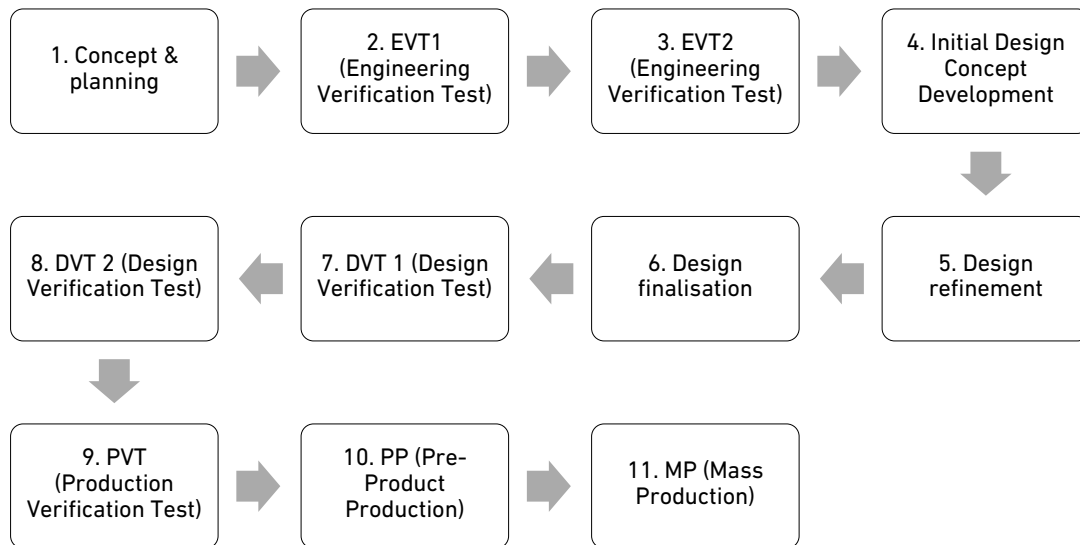


Figure 5. 8: Design process of OBM F in the NPD process

Figure 5.8 illustrates OBM F's NPD process, which is composed of eleven sequential stages: (1) Concept and planning; (2) EVT 1 (Engineering Verification Test 1); (3) EVT 2 (Engineering Verification Test 2); (4) Initial design concept development; (5) Design refinement; (6) Design finalisation; (7) DVT 1 (Design Verification Test 1); (8) DVT 2 (Design Verification Test 2); (9) PVT (Production Verification Test); (10) PP (Pre-production); and (11) MP (Mass Production).

Each stage in this linear process must satisfy a defined set of performance requirements to advance to the next phase. If any stage fails to meet these criteria, the process is repeated. These requirements are categorised into three types: functional, non-functional, and non-functional-production requirements. Functional requirements are related to performance outcomes the product must achieve. Engineers develop and test initial mechanical prototypes, often visually distinct from the final product, to confirm these requirements.

Non-functional requirements relate to product usability, ergonomics, and the expression of a coherent design language. At this stage, designers and engineers collaborate to define form factors, materials, colour schemes, textures, and finish specifications. The success of these elements significantly influences the product's visual appeal and user experience. Non-

functional-production requirements focus on manufacturability and assembly efficiency. Complex assembly processes can decrease production efficiency, elevate worker fatigue, and increase defect rates, ultimately inflating both time and costs. Therefore, ensuring these three categories of requirements are met is critical to delivering a high-quality, mass-producible product.

The initial functional validation occurs in EVT 1 and EVT 2. EVT 1 assesses the baseline functionality using a rough prototype, while EVT 2 addresses any deficiencies identified during the first test. These stages are critical for identifying latent design risks and verifying that functional requirements are met without compromising manufacturability or aesthetic goals. However, during these stages, strategic decision-making may be compromised as teams prioritise technical feasibility over design intent.

Design stages, specifically phases 4 to 6, are handled by the external design agency. In this workflow, the design team is introduced only after the engineering team has defined most of the technical outcomes. This sequencing limits the opportunity for design to shape product strategy or influence the functional-technical specifications. According to internal stakeholders, confidentiality concerns often restrict access to key technical information, further limiting the capacity of external designers to contribute meaningfully. This leads to a narrow conceptualisation of design, focusing primarily on surface-level styling.

Despite OBM F's intention to adopt design as a strategic tool, the organisational structure reveals an implementation gap. Interviews with internal personnel confirmed that design remains a subordinate function, unable to influence strategic decisions. Designers are tasked primarily with rendering the product's aesthetic shell, while the underlying technology remains beyond their influence. This disconnect between engineering and design hinders the possibility of generating integrative innovations that combine functional performance with differentiated user experiences.

During the design refinement phase (stage 5), external designers collaborate with engineers and cross-functional teams to incorporate feedback, adjust visual elements, and assess feasibility. Although this stage allows for limited interaction between design and engineering, final authority remains with the technical team. After this, the design team produces

production-ready data; however, they have no control over structural redesign or mechanism layout.

The DVT 1 and 2 stages assess whether the visual and structural elements meet the design and functional criteria established during the earlier phases. If passed, the firm proceeds to establish a pilot production line to validate the efficiency and scalability of the manufacturing process. External designers are excluded from these phases unless significant alterations to the design are required.

OBM F's case shows the structural and strategic challenges that engineering-centric ODM firms face when transitioning to a design-led OBM model. Design remains marginalised as a surface-level discipline, divorced from the organisation's strategic core. Without design integration from the conceptual phase, the potential of design to guide product identity, branding, and user experience is undermined. To transition successfully, OBM F must establish a process in which design plays an integral role from ideation through production. External design partnerships must be reframed not as outsourced services but as strategic alliances embedded within the core of the innovation pipeline. Only then can design serve as a transformative force that drives long-term competitiveness in a saturated consumer electronics market.

5.3.7 OBM firms G

5.3.7.1 Design capability and experience

OBM G began its operations as an OEM/ODM manufacturer for South Korean and international fitness equipment brands. The company initially specialised in the production of commercial and residential fitness devices including treadmills, incline treadmills, stationary bikes, and a range of weight training machines. While the global fitness equipment market has steadily grown and low-cost supply bases have flourished, OBM G struggled to maintain long-term competitive advantage due to its heavy reliance on contract manufacturing and limited market access under its own brand.

In response, OBM G sought to transition from an OEM/ODM model to an OBM framework, aiming to escape the so-called "China value trap" that limits profitability and brand influence.

The company launched an innovative exercise system under its own brand, utilising contactless motion recognition powered by a 3D camera. This product not only replicates the functionality of a personal trainer and physiotherapist but also enables the user to perform scientific fitness diagnostics such as jump testing, reaction time evaluation, and balance assessments. This strategic pivot was designed to enhance value creation, offer competitive pricing, and position the company in a differentiated space within the fitness technology market.

A unique challenge faced by OBM G during this transformation was the absence of an internal design department. The entire product development process was driven by senior management and engineering staff, who were responsible for both the internal mechanics and external industrial design of the products. While this engineering-centric approach supported functional development, it lacked the integrated design thinking necessary for optimal user experience and market differentiation.

5.3.7.2 Design process

OBM G's NPD process (Figure 5.9) is structured into six formal stages: product planning, engineering sample (ES), design development, test production (TP), pre-production (PP), and mass production (MP). This framework, as illustrated in Figure 5.8, reflects a well-defined, engineering-oriented system typical of firms evolving from OEM/ODM to OBM models. However, while the process ensures procedural discipline and technical rigour, it remains constrained in its ability to integrate design as a strategic, organisation-wide function. The following discussion expands upon each stage, drawing attention to gaps in design participation and opportunities for enhanced integration across the development cycle.

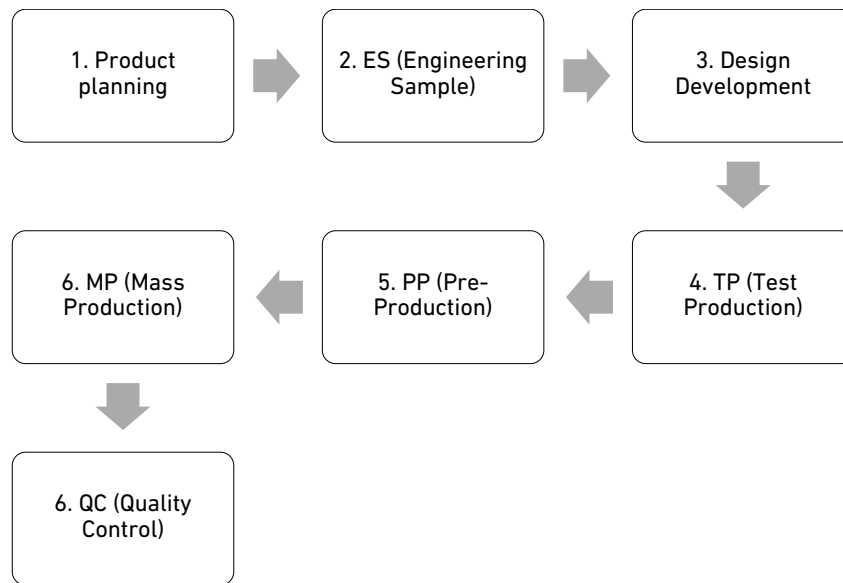


Figure 5. 9: Design process of OBM G in the NPD process

The process begins with product planning, which constitutes the fuzzy front end of innovation. At this stage, OBM G formulates product concepts based on market feedback, competitive benchmarking, and internal business goals. Activities include opportunity identification, feasibility analysis, and KPI definition covering price targets, performance expectations, and production volumes. Yet, this phase is primarily driven by marketing and engineering personnel, with minimal design input. The lack of early design participation limits the firm's ability to capture latent user needs or translate abstract insights into design opportunities. Embedding design research and trend analysis at this point could enable the company to define its strategic direction through a clearer synthesis of technology, user experience, and brand intent.

Once the product concept is approved, development proceeds to the Engineering Sample (ES) phase. Here, engineers construct working prototypes using production-grade components and moulds to validate mechanical reliability, functional performance, and durability. The ES stage is essential for establishing technical feasibility and identifying potential manufacturing constraints. However, because it occurs prior to the formal involvement of designers, the prototypes reflect purely technical logic rather than user-centred intent. If designers were involved in ES validation, their contribution could inform the configuration, ergonomics, and usability of the product at a stage where changes are still feasible.

The Design Development phase translates the engineering prototype into a consumer-oriented product. Due to the absence of internal designers, OBM G outsources this stage to external consultancies. Their responsibilities include defining the product's aesthetic identity, interface layout, materials, finishes, and ergonomic characteristics while accommodating the engineering team's pre-existing constraints. This stage marks the first alignment between design vision and production feasibility. Nevertheless, because design intervention begins only after the technical framework is fixed, the opportunity for concept-led innovation is severely constrained. A more integrated process would involve concurrent collaboration between design and engineering teams, enabling iterative co-development rather than linear handovers.

Following design completion, the Test Production (TP) stage involves limited batch manufacturing under near-real production conditions. The primary aim is to verify manufacturability, tooling accuracy, and assembly efficiency. At this stage, design quality is indirectly assessed through the lens of production practicality. When misalignments arise, such as assembly challenges or deviations from design intent, feedback loops between design and manufacturing teams become critical. However, OBM G's current workflow lacks a formal mechanism for this exchange, resulting in incremental rather than systemic improvement. Establishing a structured review protocol between production engineers and external designers would help resolve issues collaboratively, ensuring that design integrity is not compromised by manufacturing efficiency.

If TP validation is successful, the process transitions to Pre-Production (PP). This stage aims to confirm the industrial design's compatibility with full-scale manufacturing. Here, detailed assessments are made regarding component sourcing, line balancing, packaging design, and supplier coordination. In mature OBM systems, PP serves as a crucial integrative stage where technical verification, cost control, and brand expression are reconciled. In OBM G's case, however, this phase remains largely procedural, focusing on operational stability rather than learning-driven refinement. Introducing a multidisciplinary design review at the PP stage would enable the firm to align engineering efficiency with experiential and aesthetic consistency.

The final stage, Mass Production (MP), initiates full-scale manufacturing and integrates continuous quality control procedures. At this point, the product's form and function are fixed, and design teams are generally no longer involved. OBM G's focus on reliability and

consistency is appropriate given its transition toward consumer-facing products, yet this late-stage emphasis on quality assurance underscores the reactive rather than proactive positioning of design within its NPD process. Establishing a post-launch design evaluation system, assessing user satisfaction, usability, and brand perception, would close the feedback loop and contribute to organisational learning for future projects.

Taken as a whole, OBM G's NPD process demonstrates an efficient, technically grounded system that ensures mechanical precision and cost control but lacks the flexibility and creative elasticity necessary for design-led differentiation. Each stage is guided by efficiency metrics rather than by user value or brand vision, resulting in a product development paradigm that optimises performance but neglects the experiential and emotional dimensions of innovation.

This procedural orientation reflects OBM G's historical evolution from an OEM/ODM supplier of treadmills and training devices to a self-branded developer of technologically enhanced fitness equipment. Although the company has successfully leveraged engineering competence to create contactless and AI-enabled fitness systems, its limited design capability and absence of cross-functional integration have hindered the full adoption of design-led innovation. To mature into a globally competitive OBM, OBM G must reposition design as a foundational organisational resource rather than an auxiliary service.

Doing so requires the creation of internal design leadership roles, the incorporation of design expertise at the earliest stages of development, and the establishment of collaborative structures that connect engineering, marketing, and design in continuous dialogue. Furthermore, investment in design research, user testing, and iterative prototyping would allow the company to identify latent user demands and translate them into distinctive, value-driven products. The case of OBM G thus exemplifies the broader organisational challenge of transitioning from production-centric logic to innovation-centric culture.

Design integration is not merely about adopting tools or outsourcing creative tasks, it requires a fundamental shift in how the organisation perceives and manages innovation. By institutionalising design as a strategic function, OBM G can evolve from an efficiency-oriented manufacturer into a brand that delivers meaningful, emotionally resonant, and user-centred experiences. Only through such systemic transformation can OBM G achieve sustainable competitiveness as a design-driven OBM within the global fitness technology industry.

5.3.7.3 Participatory observation

The OBM G project represents the first case in which a fitness equipment manufacturer engaged an external design agency to collaborate on NPD, seeking to introduce a user-centred design perspective into a historically engineering-led production system. The company had long prioritised internal research laboratory-based mechanical design and functional validation, focusing on technical stability and manufacturing efficiency rather than user experience or market responsiveness. However, as artificial intelligence and digital technologies accelerated the emergence of user-driven markets, the company recognised the limitations of its technology-centred approach and decided to commission an external design consultancy. This initiative marked a turning point towards organisational transformation, as it challenged the prevailing development culture and tested the integration of design-led thinking into the firm's established processes.

The researcher participated in the project as the design lead from the external agency, engaging directly throughout all phases of the collaboration. The researcher's responsibilities encompassed the establishment of design strategy, market positioning analysis, coordination of communication between the client's executive management (CEO and CTO) and internal engineers, and direction of the visual and ergonomic refinement of the product. Operating as a moderate participant observer (Spradley, 1980), the researcher combined practical involvement with analytical observation, documenting the dynamics of decision-making and inter-organisational collaboration as they unfolded. This dual positionality enabled a deep understanding of the internal logic of the project and the interplay between design and engineering perspectives, while maintaining a reflective awareness of the researcher's own influence on the process. To minimise bias, field notes were taken contemporaneously during meetings and workshops, supplemented by post-session memos in which factual descriptions and interpretive insights were deliberately separated.

The observation was conducted over approximately five months encompassing the entire design and development cycle. The empirical material comprised more than one hundred records, including meeting minutes, email correspondence, instant-message exchanges, workshop notes, photographic documentation, and design drawings produced during mock-up

fabrication. All participants were informed of the research intent in advance, and anonymity was ensured for both individuals and the company. Data were collected in a non-intrusive manner so as not to disrupt the natural flow of communication during collaboration sessions.

The project followed four main phases: strategic framing, concept generation, design development, and live mock-up production. The core team consisted of the external design agency (UK-based), the internal mechanical engineering division, and the executive leadership (CEO and CTO). The design agency was responsible for creative direction, process management, and user-experience enhancement, while the internal laboratory carried out mechanical and functional verification. However, as design and engineering progressed concurrently, conflicts frequently arose between design proposals and technical constraints. Because the engineering team had already completed much of the foundational design work before the designers became involved, any aesthetic or structural modification proposed by the design team risked requiring reconfiguration of assembly components and mechanical systems. Consequently, the design team achieved time efficiency at the cost of curtailed creative experimentation. This dual-track structure exemplified the trade-off between efficiency and creativity commonly faced by small and medium-sized OBM firms during the early stages of design integration.

Fortnightly meetings were held at the company's engineering facility, where designers and engineers worked side by side, sharing data in real time and jointly addressing problems. The CEO, who also served as head of engineering, was actively involved in these sessions, not merely as a managerial figure but as a technically knowledgeable decision-maker providing immediate feedback. Meetings were structured as intensive review sessions focused on design revisions, functional optimisation, patent feasibility, and manufacturability assessment. This interactional structure created one of the few spaces in which design inputs could be negotiated and integrated within an engineering-dominant decision-making culture.

The external design team conducted market research, competitor benchmarking, and user-needs analysis to propose user-centred design concepts. Yet the extent to which these proposals could be implemented was limited, as the engineering configurations had already been fixed and functional testing was under way. Moreover, time and budget constraints typical of small-scale manufacturing environments hindered the exploration of alternative prototypes or speculative design directions. Consequently, the design activity was confined to adjustments

within the technical framework, and as the project advanced, the design team's strategic influence gradually diminished.

Following the presentation of the initial design concept, the proposal was refined through internal review into a more constrained version that reflected technical and temporal limitations. The engineering team developed detailed 3D models and entered the functional testing stage, leaving little opportunity for further design intervention. Nonetheless, a continuous feedback loop between the CEO and the design team facilitated the rapid incorporation of selected design modifications into the engineering workflow. The observation revealed that the most persistent issue was the asynchronous progression between design and engineering processes. While the design team was still engaged in ideation and user-experience exploration, the engineering team had already advanced to detailed design or pre-production modelling. This temporal misalignment reduced the effectiveness of collaboration and limited the extent to which design recommendations could be structurally integrated.

The final outcome of the project was considered successful in terms of technical performance and adherence to schedule. Within the four-month period, concept development, functional validation, and live mock-up production were all completed, and the resulting product achieved a high level of aesthetic and mechanical quality. Nevertheless, the project also revealed the structural limitations of design leadership and the absence of user-centred thinking within the organisation. The engineering culture remained dominant, with design proposals selectively adopted only when they aligned with existing technical priorities. The role of the external design agency was largely confined to improving visual form and surface quality rather than influencing strategic decision-making. Despite its visible contribution to the product's appeal, design did not yet function as an integrated organisational capability. These observations suggest that for design to gain genuine influence within such organisations, its strategic engagement must begin in the earliest phases of product planning, supported by a formally institutionalised process-management unit capable of coordinating design, engineering, and production. When such a structure is in place, design can transcend its conventional aesthetic role and operate as a fundamental driver of innovation capability.

The participatory observation of the OBM firm G project revealed how the process of integrating design into a highly engineering-centred organisation exposes both the potential and the limitations of interdisciplinary collaboration. Although the project achieved short-term

efficiency and technical success, design continued to occupy a peripheral position within strategic decision-making. Most members of the company, apart from the external design agency, were entirely unfamiliar with design-process-based working methods. The external agency therefore faced the dual task of completing the project itself, from the initial concept stage through to prototyping, while simultaneously introducing and embedding a new procedural mindset within the organisation.

For the internal members to adapt to this unfamiliar approach, a deliberate and structured strategy was required. Knowledge first had to be transmitted conceptually, followed by hands-on participation that enabled employees to accumulate practical experience. Only through repeated engagement could they begin to perceive the tangible value of design-process-driven work. Once employees had experienced a full new-product-development cycle led by design, they were expected to internalise the principles sufficiently to apply them autonomously thereafter.

This case therefore demonstrates that for an OBM enterprise to develop design as a genuine organisational capability, it must establish mechanisms for early design involvement, foster an integrated collaboration framework, and designate a formal structure or responsible leader to manage the institutionalisation of design processes. Only through such transformation can engineering-centred companies evolve into design-integrated organisations capable of sustaining long-term innovation and achieving meaningful market differentiation.

5.3.8 OBM firms H

5.3.8.1 Design capability and experience

OBM H initially operated as an OEM and ODM supplier of speaker components, sound modules, and wireless audio equipment for major global brands. By 2014, the company had grown to become a trusted manufacturing partner for several multinational home appliance and automotive technology firms, specialising in wireless speaker systems and car audio devices. However, facing intensifying competitive threats and growing demand for innovation, OBM H recognised the limitations of its legacy engineering-based design model. In response, the company shifted towards an OBM strategy in 2016, launching its own line of branded Bluetooth headphones and portable Bluetooth speakers. This strategic pivot was intended to

elevate market positioning, retain existing OEM contracts, and expand appeal beyond niche segments. Central to this shift was the establishment of an in-house industrial design team tasked with developing proprietary product forms and overseeing the tooling process.

5.3.8.2 Design process

Figure 5.10 illustrates OBM H's NPD process, structured into nine sequential stages: (1) Concept & Planning, (2) Engineering Verification Test (EVT), (3) Initial Design Concept Development, (4) Design Refinement, (5) Design Finalisation, (6) Design Verification Test (DVT), (7) Production Verification Test (PVT), (8) Pre-Product Production (PP), and (9) Mass Production (MP).

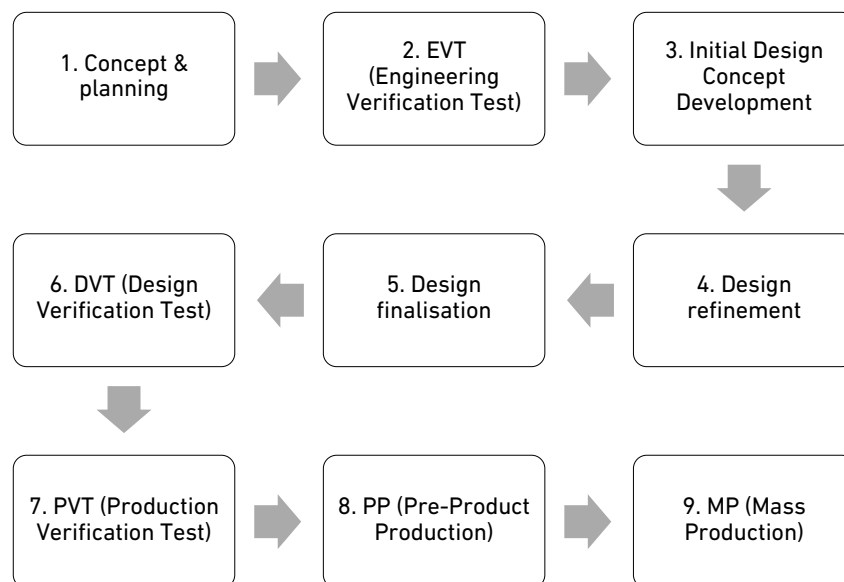


Figure 5. 10: Design process of OBM H in the NPD process

Stage 1: Concept & Planning

This stage initiates the NPD process and involves market analysis, consumer insights, and internal brainstorming to identify emerging trends and product opportunities. Strategic objectives are defined collaboratively between the marketing, engineering, and management teams. Key deliverables include the development of the Product Requirement Document (PRD), outlining functional objectives, target user groups, performance metrics, and budget constraints. This phase also assesses technical feasibility, IP considerations, and estimated return on investment.

Stage 2: Engineering Verification Test (EVT)

The EVT phase serves to validate the core functional requirements of the proposed product. Engineers construct early working prototypes using preliminary mechanical components to evaluate system-level functions such as signal transmission, audio clarity, battery efficiency, and thermal management. Importantly, the visual design at this stage remains underdeveloped, as focus lies in confirming whether the product meets safety, regulatory, and operational thresholds. Unlike later validation stages, EVT is not aimed at finalising the design but rather at surfacing unresolved issues and exploring how design decisions might impact core performance.

Stage 3: Initial Design Concept Development

Following successful EVT completion, the in-house design team, comprising five industrial designers, begins to translate technical specifications into tangible visual and ergonomic concepts. While the engineering department maintains control over internal layouts and component configurations, designers are responsible for form development, CMF (Colour, Material, Finish) strategies, user interface ergonomics, and brand alignment. However, the legacy top-down approach still limits design exploration. The predetermined engineering constraints restrict radical concept development, often resulting in incremental aesthetic improvements rather than transformative innovation.

Stage 4: Design Refinement

In this stage, design proposals are iteratively developed, evaluated, and optimised based on feedback from cross-functional stakeholders. Engineers, designers, and product managers convene to assess manufacturability, material suitability, user interaction, and cost implications. Given the cost-sensitive nature of audio equipment production, design refinements are tightly coupled with cost constraints. This often leads to friction between design intent and engineering pragmatism, especially when enhancements to form or user interface require changes to component layout or tooling.

Stage 5: Design Finalisation

Once the design has been refined to satisfy all stakeholder inputs, the final concept is locked. Designers generate complete CAD files, 3D models, and documentation required for DVT and tooling. During this phase, form factors, surface finishes, button placements, and assembly methods are finalised. However, designers have limited control over internal layout

adjustments, which are managed exclusively by the engineering team. The lack of integrated design authority reduces the opportunity to holistically optimise the design for user experience.

Stage 6: Design Verification Test (DVT)

DVT involves testing fully assembled pre-production units to ensure the final product meets design and performance expectations. Hardware and software are evaluated together to test alignment between intended and actual outcomes. Particular attention is paid to user ergonomics, audio fidelity, interface responsiveness, and device durability. This is also the point at which aesthetic inconsistencies, tactile anomalies, or fit-and-finish issues are resolved.

Stage 7: Production Verification Test (PVT)

During PVT, a pilot production line is established to simulate full-scale manufacturing. This step identifies issues related to assembly sequencing, tooling accuracy, and production throughput. Engineers analyse failure rates, quality metrics, and efficiency indicators. Occasionally, insights from this stage prompt further minor modifications to product design, although such changes are often limited due to time-to-market pressures and cost considerations.

Stage 8: Pre-Product Production (PP)

This stage involves a limited production run to confirm process repeatability, supplier performance, and packaging efficacy. All aspects of supply chain logistics are validated, including component sourcing, warehouse integration, and shipping protocols. The PP phase represents the last opportunity to address design and production misalignments before mass manufacturing is initiated.

Stage 9: Mass Production (MP)

With all validations completed, full-scale manufacturing begins. Quality assurance protocols are executed at each production stage to ensure consistency, defect minimisation, and compliance with industry standards. Although designers typically disengage from this phase, any customer complaints or post-market feedback may prompt minor revisions to industrial design or material choices in subsequent product batches.

The transformation of OBM H from a traditional OEM/ODM manufacturer into an OBM entity represents a pivotal shift in the company's strategic orientation. By building an in-house design

team and assigning it the responsibility for product form, branding, and packaging, the company made important strides toward design autonomy. However, legacy operational frameworks, driven by engineering-first logic, continue to hinder the full integration of design into early-stage strategy. While the current NPD process enables cost-effective, functionally robust products, it lacks the creative fluidity and interdepartmental collaboration necessary for market-leading innovation.

For OBM H to sustain its competitiveness in the saturated audio equipment market, design must evolve from a reactive discipline to a proactive driver of product strategy. This requires not only organisational restructuring to empower designers but also a cultural shift that embraces cross-functional synergy. Design should no longer be seen as a cosmetic afterthought but as a core contributor to business value, shaping the emotional resonance, usability, and differentiation of OBM H's products in global markets.

5.3.9 OBM firms I

5.3.9.1 Design capability and experience

OBM I founded as a joint research initiative within a South Korean university, with the mission of developing the next generation of sensor-based robotic systems capable of navigating and interacting with complex, unstructured environments. The company evolved into a specialised mechatronics firm, delivering state-of-the-art robotic system engineering to globally renowned institutions such as NASA, Google, and the United States Department of Defense. Its capabilities span complex robotic anatomy, multi-arm manipulation systems, human-robot coordination frameworks, and advanced medical robotics.

In 2017, OBM I engaged an external design agency to improve its industrial design capability and expand its appeal to a broader global audience. This collaboration marked a significant moment in the company's evolution, as it acknowledged the importance of design beyond mere technical excellence.

5.3.9.2 Design process

OBM I's NPD process consists of seven clearly defined stages (Figure 5.11):

(1) Concept and Planning, (2) Engineering Verification Test (EVT), (3) Design Development, (4) Design Verification Test (DVT), (5) Production Verification Test (PVT), (6) Pre-Product Production (PP), and (7) Mass Production. This stepwise structure reflects OBM I's technological heritage and engineering precision, yet it simultaneously reveals a fundamental limitation: design remains marginalised, entering the process only in later stages, and therefore unable to shape strategic direction or influence upstream decision-making.

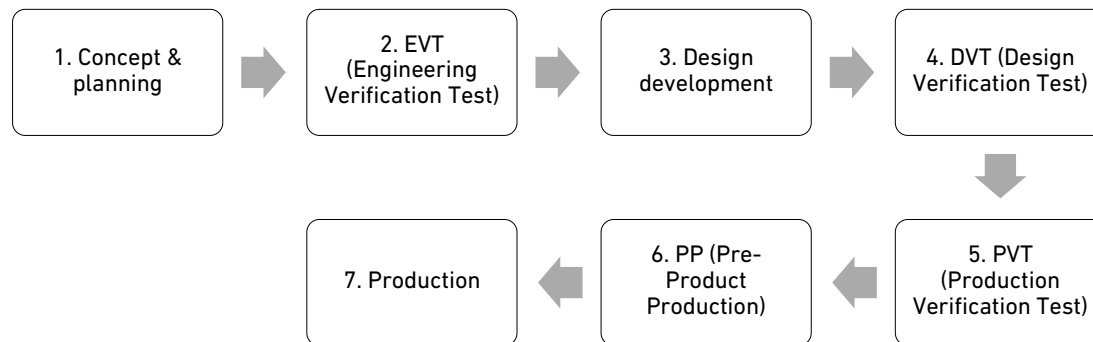


Figure 5. 11: Design process of OBM I in the NPD process

(1) Concept and Planning

This stage represents the strategic foundation of OBM I's NPD process, where the project's objectives, technological specifications, market entry timeline, and production scale are defined. It is primarily led by the R&D department and senior management, who base their decisions on market research and competitive benchmarking. However, the process remains dominated by engineering and marketing perspectives, with limited attention given to user experience, product semantics, or service flow. The absence of design participation at this point results in a structural deficiency: the product's identity and user-centred value propositions are excluded from the formative stages of planning. For instance, while performance and cost efficiency are managed through quantifiable KPIs, aspects such as user emotion, product experience, and brand consistency are not established as evaluation criteria. Embedding design research, user journey mapping, and persona analysis within this early phase would enable the company to shift from a technology-driven to an experience-driven strategy, allowing design to frame the project's strategic direction from inception.

(2) Engineering Verification Test (EVT)

During the EVT phase, engineering samples are developed to validate the mechanical and electrical performance of the product. The prototypes are tested for functional stability, durability, heat resistance, and safety, ensuring that core technologies perform reliably under technical constraints. However, design involvement remains minimal. As a result, structural completeness is achieved, but ergonomic and experiential dimensions are overlooked. OBM I's EVT process is highly effective in verifying technical feasibility, but the absence of an iterative feedback loop between design and engineering causes usability or aesthetic issues to be identified belatedly. If the design team were integrated at this stage, concurrent validation of form, function, and user interaction could be conducted, reducing redesign costs and improving alignment between engineering logic and user experience.

(3) Design Development

Following EVT, the Design Development stage marks the formal entry of the design team into the process. While internal designers lead this phase, their activities are constrained by engineering specifications that have already been fixed. Consequently, design work is limited to refining the product's external form, selecting colours, materials, and finishes (CMF), and improving interface layouts, rather than engaging in conceptual direction or user experience strategy. In this structure, design functions primarily as a post-processing stage, adding visual refinement to pre-determined engineering outputs. For example, interface layouts and component arrangements are typically finalised by the engineering team, leaving the designers to make only minor visual adjustments such as alignment or contrast correction. A more integrated model would introduce cross-functional workshops and co-prototyping sessions, allowing design and engineering to iterate collaboratively and develop shared ownership over the final outcome.

(4) Design Verification Test (DVT)

The DVT stage involves the evaluation of completed prototypes in terms of aesthetics, ergonomics, and user interaction. However, in OBM I, these evaluations focus largely on surface-level visual quality and finishing rather than empirical usability or user experience testing. Design verification is thus treated as a formal approval procedure, rather than as a platform for organisational learning. Without user testing, scenario analysis, or brand perception assessment, the company misses opportunities to accumulate design knowledge or enhance decision-making based on evidence. Transforming DVT into a design learning platform, where usability experiments, cognitive walkthroughs, and brand consistency analyses

are conducted systematically, would enable OBM I to institutionalise data-informed design practices and move beyond aesthetic judgement toward measurable value creation.

(5) Production Verification Test (PVT)

At this stage, limited-scale production runs are carried out to test manufacturability, assembly precision, and production efficiency under actual factory conditions. The process is led by the engineering and production teams, while the design team participates only upon request when inconsistencies arise. This reactive involvement often leads to the dilution of design intent during manufacturing, for instance, curves, textures, or details may be simplified to improve production yield or cost efficiency. The lack of a formal review mechanism between design and production departments results in design decisions being overridden by operational constraints.

Introducing design–manufacturing review meetings at this stage would allow collaborative evaluation of the product’s form, assembly, and visual integrity, thereby ensuring alignment between design fidelity and production efficiency.

(6) Pre-Product Production (PP)

The PP phase focuses on validating tooling, material sourcing, packaging design, and assembly line balancing. It is managed predominantly by the production control department, with the design team only occasionally involved in reviewing packaging or visual branding. However, this stage represents the final opportunity for design intervention before the transition to mass production, making it critical for preserving brand coherence. Conducting a design consistency audit at this stage, evaluating material uniformity, brand tone and manner, and perceptual consistency, would strengthen the product’s identity and facilitate design standardisation in subsequent production cycles.

(7) Mass Production

The final stage involves full-scale manufacturing, with quality control procedures ensuring mechanical reliability and operational stability. At this point, the design team is typically disengaged from the process, re-entering only when market feedback reveals usability or aesthetic issues post-launch. This reactive approach limits the company’s ability to capture user insights and transform them into design knowledge for future projects. Establishing a post-production design evaluation system, which assesses user satisfaction, product usability, and

brand perception, would enable OBM I to close the feedback loop and integrate real-world data into early design planning.

OBM I's NPD process demonstrates a high degree of technical precision and procedural discipline, yet design remains structurally isolated from strategic and conceptual decision-making. The late entry of design in the process confines its influence to aesthetic aspects, while opportunities to define product meaning and user experience are lost. Moreover, the collaboration between departments follows a sequential logic, where learning is unidirectional and reactive rather than iterative and integrative.

For OBM I to evolve into a design-led OBM firm, it must internalise design not as an aesthetic enhancement but as a core organisational competence. This transformation requires both structural and cultural shifts. First, design leadership should be formally embedded in the decision-making hierarchy from the earliest planning stages. Second, a parallel development model should be institutionalised, where design and engineering work interactively rather than sequentially. Third, design research, prototyping outcomes, and user validation data should be managed through a design knowledge management system, allowing organisational learning to accumulate systematically across projects.

The case of OBM I exemplifies the structural imbalance commonly observed in technologically advanced yet design-immature firms transitioning from OEM/ODM to OBM models. Despite its technological excellence in robotics and close partnerships with research institutions, OBM I's innovation logic remains predominantly engineering- and research-driven, a paradigm that ensures technical efficiency but limits the company's capacity to create meaningful user experiences and build brand value. In this context, sustainable competitiveness in the industry will hinge on the organisation's ability to harmonise technological capability with human-centred design innovation. To achieve this, OBM I must redefine design not as a means of visual refinement but as a strategic resource that maximises user value and drives innovation outcomes. Through this transformation, OBM I can transcend its engineering-centric origins and establish a globally competitive, design-driven identity.

5.3.9.3 Participatory observation

The OBM I project represented the first collaborative endeavour between a university-based venture company and an external design agency, serving as an experimental attempt to embed user-oriented design approaches within a technology-dominant product development system. The company, which had evolved from an academic robotics research laboratory, had long maintained a culture that prioritised mechanical precision, engineering validation, and performance efficiency over user experience or market responsiveness. However, as the company's robotic products increasingly demanded user-friendly interfaces and experiential refinement, it became evident that an engineering-driven model alone could no longer ensure competitiveness or differentiation. To address this challenge, the firm commissioned a professional design consultancy to lead a new design-led approach to product development grounded in user insight and design thinking.

This project thus became the company's first structured experiment in integrating design and engineering methodologies within a research-led industrial context. The external agency was commissioned to develop a collaborative robot while simultaneously establishing a coherent design identity for the company's emerging brand. The collaboration combined tangible outcomes, such as product form development and usability validation, with intangible ones, including the formulation of a design philosophy and the creation of a visual and behavioural identity system. The observation revealed that this collaboration required an ongoing translation process between two fundamentally different disciplinary logics: the empirical, test-oriented epistemology of robotics engineering and the synthetic, iterative reasoning of design. While the engineering team focused primarily on function, control systems, and manufacturing constraints, the design agency introduced conceptual framing, user scenario development, and sensory interaction analysis, thereby broadening the development framework to include human-centred considerations.

The researcher participated as the design lead within the external agency, assuming full operational responsibility for the project's strategic and creative direction. This included defining the design strategy, conducting market and competitive analyses, assessing the company's design capabilities, mediating communications between the client's executive leadership (CEO and CTO) and its engineering teams, and setting the design language and user experience direction. Unlike moderate participation that balances involvement and detachment,

the researcher's role was one of active participation (Spradley, 1980): deeply embedded in the design process, directly influencing decision-making, design execution, and inter-organisational negotiation. This positioning was methodologically necessary rather than incidental, as it allowed for an embodied understanding of how design could be integrated within a highly technical organisational environment.

The design activities began with the refinement of the robot's 3D geometry, integrating material feasibility and cost considerations to generate production-level data. In parallel, the design consultancy developed a comprehensive brand identity platform for Rainbow Robotics, establishing design principles that synthesised precision engineering with visual simplicity and emotional resonance. The design process thus extended beyond product form development to encompass corporate image definition. Based on in-depth analysis of the company's organisational structure, market position, and communication patterns, the agency constructed a brand identity framework articulating both visual and behavioural attributes. As documented in the third-year progress report, this framework was formalised through a "convergence and divergence" workshop that defined the firm's core brand values, professionalism, imagination, and openness, which were later translated into the corporate visual identity and design manual. These activities culminated in the redesign of the company's logo, typography, and product communication materials, aligning the internal R&D culture with a cohesive and recognisable design language for external stakeholders.

Usability evaluation constituted another critical component of the collaboration. Based on findings from the first phase of user testing, the design agency implemented refinements to improve interface accessibility, operational ergonomics, and task visibility. A second evaluation was subsequently conducted with actual users to validate these improvements and identify further design optimisations prior to production. The final deliverables comprised a series of functional mock-ups, marketing applications, and a fully engineered product prototype, which was later submitted to international design competitions such as the Red Dot Award and iF Design Award.

From an organisational standpoint, the participatory observation illuminated the substantial difficulties of embedding a design-led process within a firm whose culture remained deeply engineering-centric. Most employees, apart from the external design agency, had little to no prior exposure to design-process-based methods. Consequently, the agency carried a dual

responsibility, not only producing the design deliverables but also introducing a procedural process of design-driven collaboration to the company's internal teams. To enable this transition, design knowledge was transferred progressively: from conceptual explanations to hands-on engagement through workshops, prototyping sessions, and usability evaluations. This iterative process allowed internal members to experience the tangible benefits of design-led workflows and develop practical familiarity with process-oriented thinking. Once the company's engineers had completed a full NPD cycle under design leadership, they began to internalise the principles and apply them autonomously in subsequent projects.

Through this process, active participation provided the researcher with unique access to the lived dynamics of interdisciplinary collaboration, exposing the communicative tensions, iterative negotiations, and learning mechanisms through which design was gradually legitimised as part of the firm's operational logic. The researcher's dual role as practitioner and observer enabled the documentation of subtle organisational transformations, including engineers' growing recognition of design's strategic value and a gradual shift from task-oriented execution to user-oriented innovation. The participatory framework thus revealed not only the tangible outcomes of the project, such as refined product form and enhanced usability, but also the cultural transformation in the company's innovation practices.

This case identifies that design participation can function simultaneously as both a developmental and a pedagogical mechanism within emerging OBM enterprises. It underscores that to transform design into a sustained organisational capability, firms must institutionalise design participation at the earliest stages of product planning, establish integrated collaboration frameworks, and designate dedicated units or roles responsible for design process management and systematisation. Only through such structural commitment can engineering-oriented companies evolve into design-integrated organisations capable of maintaining long-term innovation and achieving meaningful market differentiation.

5.3.10 OBM firms J

5.3.10.1 Design capability and experience

OBM J is a South Korean company, specialising in the development, manufacture, and commercialisation of sensors and environmental measurement devices, including temperature

and humidity sensors, air quality monitors, and a range of modular products. The firm possesses advanced in-house facilities at the level of semiconductor manufacturing, such as a six-inch MEMS fabrication plant, and has secured the capacity to carry out the entire production process independently. This process encompasses material synthesis, chip fabrication, module packaging, calibration, and testing. Such vertically integrated production capabilities not only enhance product quality and technological reliability but also serve as a foundation for meeting the demands of international clients and major electronics manufacturers.

OBM J complies with international quality and environmental management standards, thereby reinforcing its credibility and competitiveness in global markets. In recent years, the company has focused on the development of dew point hygrometers capable of accurately measuring ultra-low humidity in battery manufacturing processes, while also investigating alternative approaches, such as the ‘child-mirror’ principle, to overcome the inherent limitations of chip-based technologies. Through such diversification, OBM J has sought to enhance both the reliability and applicability of its measurement technologies, while simultaneously broadening its business model from the mere supply of sensors to the delivery of integrated solutions that encompass installation, wiring, and maintenance. Over time, the company has developed fully internalised competencies across the entire sensor production chain and has more recently extended its activities into emerging fields such as battery systems and smart manufacturing. This trajectory demonstrates a strategic orientation in which high-precision sensor technologies are positioned as core assets, enabling the firm to establish itself not only as a component supplier but also as a comprehensive provider of system-level solutions.

OBM J has grown on the strength of its technological capabilities in the field of sensors and environmental measurement devices, with its early NPD processes being conducted within a framework that was almost exclusively research and development (R&D) oriented. The entire product development cycle was led by the research laboratory, with emphasis placed on technical verification and performance enhancement, while design and production were focused on component optimisation and manufacturing efficiency. This approach allowed OBM J to achieve technological self-reliance; however, it involved little conceptual or strategic engagement with design. In practice, the company did not treat design as an independent source of value but instead looked to the finished products of European competitors in order to replicate similar external appearances. Consequently, design was regarded as a supplementary

function, limited to superficial visual emulation rather than being recognised as a strategic resource.

As global competition intensified and user experience (UX) emerged as a crucial factor in product selection, OBM J came to recognise the limitations of its technology-centred NPD processes. At this turning point, the firm undertook its first substantive design project in 2019 through collaboration with a British design agency. The project extended beyond merely improving product appearance and aimed to secure both aesthetic quality and user-friendly experience. The design agency contributed expertise in the structural redesign of sensor exteriors, in enhancing the intuitiveness of user interfaces (UIs), and in deriving form and material solutions that reflected the contextual environments in which products are deployed. This constituted a new paradigm for OBM J, which had previously approached product development primarily from the perspective of functionality and durability.

The collaboration served as a catalyst for the evolution of OBM J's NPD process, transforming it from a purely technology-driven pathway to a more integrated trajectory in which design and technology coexisted. In particular, design thinking was incorporated from the early stages of idea generation and concept design, so that the objective shifted from merely producing functionally adequate devices to developing products that could be intuitively understood and positively experienced by users. Moreover, in the prototyping phase, visualisation and usability validation were undertaken in parallel with functional testing, thereby expanding the scope of a development process that had hitherto been restricted to technical verification.

The design project was therefore more than a simple case of external collaboration for OBM J. It reflected the reality that technological superiority alone does not guarantee sustainable differentiation in global markets, and it triggered an organisational cultural shift towards recognising design as a strategic resource. Furthermore, OBM J began, on the basis of this experience, to integrate design as an independent axis of value in subsequent projects. This development can be interpreted as a significant case in the enhancement of maturity for an OBM firm, demonstrating the transition from a function- and performance-oriented organisation to one that strategically embraces design as a driver of competitiveness.

5.3.10.2 Design process

The NPD process of OBM J (Figure 5.12) comprises eleven distinct stages and is characterised by a complex interaction between technology-oriented hardware development and a design process that is not yet fully integrated but operates in a parallel and adaptive manner. In the early stages, the focus remains on defining the technological feasibility and functional architecture of the product, while in the mid-to-late phases, design participation becomes more pronounced, shaping the product's form, emotional resonance, and overall user experience. Notably, the design process is formally introduced at the 'HW: E/S board development' stage, from which point four sub-stages are conducted concurrently: Initial Concept Proposal, Design Refinement, Design Finalisation, and Design Mock-up Development. This structure represents a shift from a strictly sequential engineering workflow towards a semi-integrated, concurrent development process that allows limited but meaningful design participation.

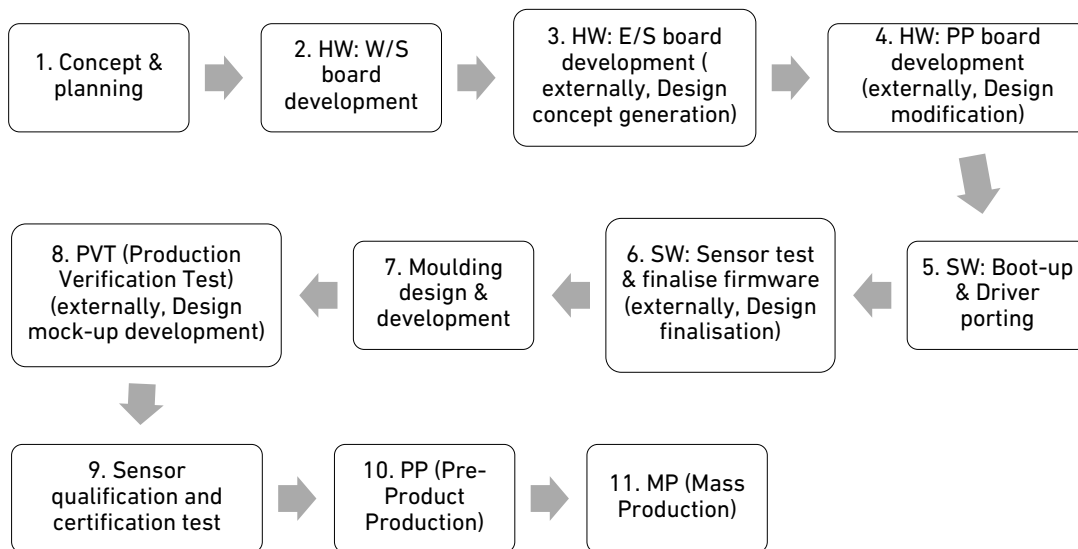


Figure 5. 12: Design process of OBM J in the NPD process

During the Concept Planning and Specification Definition stage, the product's market potential and competitive positioning are analysed, and the core functional requirements are established. The R&D team defines the technical specifications, key performance targets, and structural framework, identifying essential technological components such as sensor precision, communication stability, and power efficiency. The outputs from this stage serve as foundational data for both subsequent engineering sample development and design conceptualisation. In the following HW: W/S board development phase, circuit design and

component verification are conducted to confirm the product's operational feasibility. At this point, design involvement remains absent, as the primary objective lies in verifying logical consistency and ensuring the hardware's technical stability.

Design intervention begins at the HW: E/S board development stage, where the engineering sample (E/S board) provides a tangible platform for design collaboration. As the hardware structure becomes more concrete, the external design consultancy joins the process to undertake the Initial Concept Proposal. The design team formulates the visual identity and morphological direction of the product, exploring feasible design solutions within the boundaries imposed by engineering constraints. In practical terms, the consultancy analyses internal component layouts and structural limitations to propose alternative configurations that enhance ergonomics, form factor, and user experience (UX). This stage transcends mere aesthetic exploration, serving instead as a strategic design conceptualisation phase that considers brand direction, product positioning, and long-term identity formation.

The subsequent HW: P/P board development stage marks a dual progression of technical reliability verification and design refinement. From the engineering perspective, the focus lies on assessing circuit integrity, heat dissipation, and power stability. Simultaneously, the design team engages in Design Refinement, addressing proportional balance, assembly structure, and CMF (Colour, Material, and Finish) coordination. Designers and engineers engage in iterative feedback cycles to align internal component layouts with external form. Visual prototypes (rendering-based models) and engineering prototypes (functional models) are developed and compared, establishing a process of co-adjustment that integrates aesthetic precision with mechanical feasibility. Through this phase, the design process becomes progressively embedded within the engineering logic of the organisation.

At the SW: Boot-up and Driver Porting stage, firmware installation and system operation testing commence, marking the initial convergence of hardware and software. Here, the design team transitions into the Design Finalisation phase, verifying coherence between the user interface (UI) and the physical interface. Button layout, tactile feedback, indicator placement, and packaging configuration are systematically reviewed to ensure that functional interactions align with visual and experiential consistency. The design is fine-tuned based on usability testing and engineering feedback, resulting in a balance between visual resolution and

functional integrity. This stage demonstrates that design serves not as a decorative afterthought but as a mediating mechanism between technological performance and human interaction.

During Moulding Design and Development, mould fabrication begins while the design team concurrently undertakes Design Mock-up Development. This stage involves creating a full-scale prototype using production-equivalent materials, enabling the evaluation of visual fidelity, assembly precision, durability, and handling ergonomics. In parallel, the R&D centre conducts the Sensor Qualification and Certification Test, verifying that the product's core sensors meet industry standards for accuracy, stability, and durability. The integration of mock-up results with certification data facilitates a final synthesis between technical credibility and user satisfaction, confirming that the product satisfies both engineering reliability and experiential value.

In the final stages, PVT (Production Verification Test), PP (Pre-Production), and MP (Mass Production), direct design participation gradually diminishes, but the design language and UX guidelines established in earlier stages are embedded throughout the production process. Design consistency is maintained through quality inspection and production sampling, ensuring that visual and emotional coherence is preserved in market-ready products. The design team thus assumes a supervisory role, safeguarding the integrity of design intent during mass production.

OBM J's product development process reflects a transitional model in which design becomes involved only after the E/S board development stage, operating in a concurrent yet subordinate capacity within a technology-dominant framework. While design participates strategically from concept proposal to mock-up construction, it does not yet function as a true mediating force between technology and user experience. This limitation underscores a persistent immaturity within OBM firms that perceive design primarily as an auxiliary means of materialising technological innovation rather than as a strategic driver of value creation. The case of OBM J thus exemplifies the structural imbalance typical of R&D-intensive manufacturing organisations, wherein design remains a supportive discipline rather than a core strategic capability. Nevertheless, it provides critical insight into the developmental trajectory of design integration in technology-based OBM enterprises, highlighting both the constraints and emerging opportunities for achieving a genuinely design-led innovation framework.

5.3.10.3 Participatory observation

The OBM J project represented the first collaborative attempt by a South Korean sensor and environmental measurement company to work with an external design agency, serving as a pioneering case in which a user-centred design approach was experimentally introduced into a technology-driven product development system. OBM J, which had grown by independently developing and manufacturing a range of modular products such as temperature and humidity sensors and air-quality monitors, had long embodied a laboratory-oriented organisational culture that valued engineering precision, technical verification, and performance efficiency above all else. However, as competition in the sensor market began to shift from functional performance to factors such as user experience (UX), interface refinement, and emotional reliability, the company gradually recognised the limitations of its traditional engineering-centred approach. In response to this awareness, OBM J engaged a British design consultancy to integrate design thinking and user insight into its product development process.

This project marked the company's first structured experiment in combining user experience-oriented thinking with its existing semiconductor-based technological system, creating a testing ground in which the distinct logics of engineering and design were practically merged. Observations revealed that the collaboration unfolded as a continuous process of translation, involving the parallel transmission of fundamental design knowledge and procedural understanding. While the engineering team remained focused on functionality, control systems, and manufacturing constraints, the design team introduced conceptual framing, user-scenario development, and sensory-interaction analysis, thereby embedding the human experience dimension into a highly technical structure. In the early stages of collaboration, an internal workshop was conducted to identify the company's core attributes and value propositions. Participants defined their corporate character using keywords such as expert, honest, challenging, and passionate. Yet, the same workshop revealed low self-assessments for attributes such as disruptive, flexible, and imaginative, exposing the company's awareness of its limited capacity for creative innovation. One senior manager notably remarked, "We lead the industry in technology, but we are weak at explaining or visualising that technology for people," a statement that underscored the growing realisation that design was not about aesthetic embellishment but about translating the language of technology into human understanding.

The project spanned approximately six months and involved parallel collaboration between the internal sensor-engineering and external design teams. Following the official kick-off meeting, key deliverables and validation milestones were established, and the design team initiated trend analyses and visual alignment exercises to determine the design direction. However, by the time of the first review, the internal engineering specifications had already been finalised, leaving little room for design modification. The engineering team, accustomed to repeated testing and verification, perceived design revisions as synonymous with project delays and cost increases; consequently, a significant portion of the design agency's proposals were not implemented. During the mid-phase of development, the first functional prototype (Function Test 1) was assembled and evaluated, allowing limited exchanges of feedback between engineers and designers. Nevertheless, the design team's role became increasingly auxiliary. One engineer stated, "We've already completed the internal structure, any design change means we need to test everything again," reflecting a deep-seated concern about the practical burden that design interventions imposed on technical workflows. This empiricist mindset, characteristic of engineering rationalism, framed design as an additional aesthetic function rather than an integral process. As a result, the second functional prototype (Live Mock-up) was ultimately cancelled due to budgetary and scheduling constraints. Although the Live Mock-up had been intended as a fully functional prototype for ergonomic and user testing, OBM J's experience and internal capability were insufficient to manage the integration of exterior design with its sensor-focused engineering expertise.

During this period, the engineering team conducted two internal rounds of functional testing (Function Tests 1 and 2) and held on-site discussions with the design agency regarding the integration of hardware and software elements. Yet no concrete plan for implementation or technical coordination emerged. Consequently, the parallel structure between engineering and design gradually weakened, and the project concluded with only the internal specifications finalised without completion of the external product design.

Despite a clear division of responsibilities and systematic project management at the outset, collaboration intensity declined in the later stages, as each division began to operate independently. The logical sequence of design trend review, mock-up validation, and functional testing was maintained in form but weakened in practice, reverting to an engineering-dominant process. As cooperation between the external design consultancy and

the internal research laboratory diminished, the project ultimately achieved technical reliability but failed to deliver the intended level of design quality or user-oriented innovation.

The researcher participated as the design lead within the external design agency, assuming responsibility for the project's strategic direction and creative vision. This role encompassed the formulation of design strategy, market and competitor analysis, assessment of the company's internal design capability, coordination between executive leadership (CEO and CTO) and engineering teams, and the establishment of user experience and design language frameworks. The researcher's engagement constituted active participation in Spradley's (1980) typology, an immersive form of ethnographic involvement in which observation and practice are inseparable. This methodological choice was not incidental but essential: the aim of the study was to explore how design could be integrated into a technology-centred organisation's development process, a phenomenon that could only be authentically examined through direct, embodied participation.

Throughout the project, the researcher acted not only as a designer but also as a practitioner, educator, and change agent. Given that most employees lacked prior exposure to design-process-based methods, the researcher facilitated knowledge transfer incrementally beginning with conceptual explanation and advancing through workshops, prototyping, and user-evaluation sessions. This iterative learning process enabled some engineers to appreciate the practical value of design-led development. However, organisational adoption of design as a strategic resource remained constrained by structural and cultural barriers.

The participatory observation revealed that, in practice, the design-led collaboration operated largely as a form of outsourced engagement, functioning within the boundaries of existing technical decision-making hierarchies. The researcher directly experienced the communicative tensions, recurring negotiations, and learning curves that characterised the collaboration, observing how design failed to become fully internalised within the organisation's operational logic. Engineers found it difficult to recognise the strategic value of design and remained uncertain about transitioning toward user-oriented thinking.

The OBM J project thus illustrates the structural limitations and practical difficulties encountered when applying a design process wholesale to a technology-oriented OBM firm with low design maturity. This study demonstrates that, for such firms to develop design into

a sustainable organisational capability, design participation must be institutionalised from the earliest stages of product planning, framed in terms that are comprehensible and persuasive to engineers, and supported by an integrated collaboration framework. Furthermore, a dedicated organisational foundation must be established to oversee design process management and systematisation. Only through such structural transformation can engineering-centred OBM enterprises cultivate long-term innovation capabilities and achieve sustainable market competitiveness.

5.4 Comparison of OBM firms

This chapter presents a comparative analysis of ten firms (OBM A–J), Table 5.3, that have transitioned from OEM or ODM to OBM. The analysis focuses on their approaches to design integration, product development strategies, organisational structures, and market response mechanisms. The purpose of this comparison is to identify the structural and strategic constraints faced by technology-oriented manufacturing firms when attempting to internalise design-led innovation capabilities, and to determine the organisational conditions required for the institutionalisation of design as a core competence.

Table 5. 3: Comparison of design integration and maturity among OBM Firms (A–J)

Firm	Organisational structure for design	Timing of design involvement	Form of collaboration	Key characteristics and strategic implications
OBM A	No internal design team; relies on external consultancies	Early (but after engineering specification)	Outsourced / agency-based	Early collaboration attempts with external designers, but sequential workflow constrained strategic design impact. Design decisions remained subordinate to engineering.
OBM B	Small in-house design team under R&D supervision	Mid (after engineering completion)	Hybrid (internal + limited external)	Recognised design's potential, yet organisational hierarchy and R&D dominance limited early-stage integration.
OBM C	Small design unit; external contractors used	Late (styling and finishing phase)	External-only	Design treated as a cosmetic function; no formalised design learning; design viewed as peripheral to technology.
OBM D	R&D-led structure with consistent external collaboration	Early (concurrent with concept and planning stages)	Collaborative partnership model	Parallel integration between design and engineering; early user insight adoption; design contributes to brand coherence.
OBM E	Small internal design team within technology division	Mid (from planning through production)	Internal-led with technical cooperation	Continuous design participation across NPD; still functionally supportive rather than strategically directive.

OBM F	Engineering-driven; occasional external design input	Mid-late (post-engineering verification)	External subcontracting	Focused on aesthetic refinement; limited communication between design and engineering; low strategic design awareness.
OBM G	No design personnel; engineering team leads form design	Late (pre-production or packaging stage)	External packaging support only	Design marginalised; engineering defines all product form factors; weak user and brand alignment.
OBM H	Independent in-house design team	Mid-late (after PRD phase)	Internal coordination	Formal design management system introduced; however, late involvement limits innovation and concept exploration.
OBM I	R&D-centred organisation; design plays support role	Mid (after internal mechanical completion)	Internal collaboration within R&D	Strong technological innovation capability, but usability and emotional engagement remain underdeveloped.
OBM J	No design team; R&D laboratory-led development	Mid-late (introduced from HW: E/S board development stage)	Minimal or non-existent collaboration	No design experience or literacy; design introduced reactively alongside engineering; design thinking entirely absent.

Most of the examined OBM firms initiated their transition after recognising the inherent structural limitations of the OEM/ODM model, specifically, declining profitability, dependency on external clients, and the absence of brand identity. OBM A, B, and C established their own brands based on their manufacturing competencies, whereas OBM D and E adopted OBM strategies in response to global competition and diminishing subcontract demand. Meanwhile, OBM G, H, I, and J aimed primarily to develop brand equity and achieve market diversification. In particular, OBM J remains in the early phase of OBM transformation, maintaining an R&D-centred development structure with virtually no established design function, an archetypal case of a technology-driven firm lacking design maturity. These contextual factors directly influence each firm's product development structures and approaches to design integration.

Across most cases, the NPD framework follows the conventional linear engineering sequence of EVT–DVT–PVT–PP–MP. However, the mode and timing of design involvement vary significantly across firms. OBM A and D experimented with early collaboration with external design consultancies, though their sequential development structures limited the strategic influence of design. OBM B, E, and H maintain in-house design teams, yet design involvement still occurs post-engineering, rendering it secondary and reactive. OBM C and F rely primarily on external agencies for surface styling and aesthetic refinement, while OBM I and J exhibit

R&D-dominant organisational cultures in which design lacks strategic autonomy. In particular, OBM F, G, and J have no internal design teams and no previous collaboration experience with design consultancies, resulting in design processes being formally introduced only in the late stages of development. Consequently, OBM J, despite its technical achievements, demonstrates notably low market competitiveness in terms of visual completeness and user experience.

The comparative findings indicate that the position and authority of design within the organisation are decisive factors influencing the success of design integration. Although OBM H possesses an internal design team, its involvement begins only after technical specifications are confirmed, excluding it from conceptual planning. OBM F, G, and J lack any internal design personnel, with engineers determining product form and external contractors handling packaging. These firms share a structural pattern in which design has no role in strategic decision-making, and product form development remains constrained by engineering limitations. Conversely, OBM E allows its design team to participate throughout the development process, though its function remains confined to feasibility support rather than strategic direction. OBM I similarly operates under an R&D-dominant structure, where designers act as technical assistants rather than innovation leaders, with little contribution to user experience or brand identity formation.

Organisational perception of design value further reinforces these structural disparities. OBM A, B, and D began recognising the strategic potential of design following international design award recognition, yet these acknowledgements did not translate into substantive internal reforms. OBM D and H acknowledged design as a competitive differentiator, but within production- and cost-oriented cultures, its strategic influence remained marginal. OBM F, G, I, and J treated design merely as a means of visualising technical completeness, focusing on surface styling and minor aesthetic correction. Notably, OBM J exhibits a complete absence of design experience or design thinking, operating within an engineering-dominated environment where R&D activities drive every stage of decision-making.

Most OBM firms also exhibit limited cross-functional collaboration, with communication between design and engineering typically following a sequential handoff model. OBM G, I, and J initiate design work only after technical development is completed, precluding opportunities for reciprocal feedback. OBM H introduces its design team only after the PRD phase, which restricts meaningful involvement in concept development. Such structures limit

the strategic creativity of design and constrain its ability to enhance differentiation, usability, and brand storytelling.

From the perspective of design maturity, most OBM firms remain at the operational level, viewing design primarily as a tool for aesthetic enhancement rather than a driver of strategic decision-making. Nonetheless, the internalisation of design-led thinking is gradually emerging in some firms. OBM C and F have begun forming partnerships with global design agencies and establishing design research systems that connect product planning with design intent. OBM H has introduced a formal design management system, signalling an institutional attempt to embed design within its organisational structure. In contrast, OBM J lacks any internal design capability and remains in a pre-formation stage in which design is entirely subordinate to technological development. This makes OBM J a representative example of the structural limitations encountered when technology-based OBM firms fail to institutionalise design.

The comparative analysis reveals that the timing of design involvement (early vs. late integration) and the degree of cross-functional coordination are the principal determinants of design's strategic impact. Firms such as OBM D and E, which incorporate design concurrently from the early stages of development, demonstrate higher adaptability in product innovation and greater consistency in brand identity. Conversely, firms adhering to strictly engineering-dominant structures, such as OBM G, I, and J, exhibit limited design autonomy, resulting in fragmented user insight and weak product identity.

These findings align closely with S. Bolton's Half Step Innovation (HSI) model (2009), which conceptualises the transition from OEM to ODM to OBM not as a mere change in production mode, but as a gradual organisational evolution grounded in learning, capability building, and cultural adaptation. In the early OEM phase, design existed only as an outsourced service; during the ODM phase, firms began cultivating internal design expertise and establishing stronger linkages between R&D, marketing, and strategy; in the OBM phase, design evolved into a central driver of user-centred innovation, organisational learning, and long-term brand development. This transformation was not the outcome of hiring professional designers alone but of iterative learning cycles, cultural assimilation, and structural reconfiguration.

The HSI framework demonstrates that design integration is not a discrete intervention but a continuous, multidimensional process. Each stage increases the sophistication, strategic

alignment, and cross-functional collaboration of design activities, transforming design from a superficial styling function into a mechanism for user experience innovation, brand narrative construction, and value differentiation.

Ultimately, for OBM firms to achieve sustainable growth in an increasingly complex and uncertain global market, design must be recognised not as a peripheral support activity but as a core pillar of organisational innovation. When design is fully internalised, firms can minimise innovation risks, enhance product–market fit, and build the organisational agility required to respond effectively to environmental change. Thus, for OEM/ODM-based firms to make a genuine leap towards OBM, design must be integrated as a structural mechanism connecting strategy, branding, and technology. Moreover, design processes must be flexibly configured in accordance with industrial characteristics, market positioning, and growth strategy; a one-size-fits-all approach is insufficient for effective innovation.

The comparative analysis of OBM A through J demonstrates that design integration is neither linear nor universal, but a dynamic process continuously shaped by organisational culture, leadership, and strategic intent. Firms that internalise design as a cognitive, developmental, and pedagogical mechanism are more likely to translate their technological capabilities into market-oriented innovation and long-term brand value. Therefore, design should not be regarded as a supplementary function of production, but rather as a structural and strategic engine driving sustainable competitive advantage throughout the OBM transformation process.

5.5 Chapter summary

Chapter 5 presented an in-depth empirical investigation of ten OBM firms (OBM A–J), examining how manufacturing-centred enterprises transitioning from OEM/ODM models to OBM structures have introduced, integrated, and institutionalised design within their organisational and product development systems. Through comparative case analysis, the chapter explored the structural, procedural, and cultural mechanisms by which design contributes to innovation capability and competitive advantage.

The findings revealed that the majority of OBM firms remain engineering-dominated in their NPD structures, where design typically enters only after the engineering verification stages

(EVT, DVT, PVT). Such delayed involvement confines design to a supplementary and post-hoc role, thereby weakening its strategic influence and excluding it from the early phases of product planning and technological decision-making. Conversely, firms that introduced design involvement from the earliest stages, such as concept formulation, requirement definition, and strategic planning, demonstrated stronger coherence between technical feasibility and user experience, resulting in more distinct brand identities and enhanced product competitiveness.

The institutionalisation of design was found to rely on the concurrent development of two interdependent dimensions: structural management and cultural transformation. Structurally, firms that formalised roles such as design coordinators, process managers, or internal design management systems achieved smoother inter-departmental alignment and more consistent design integration. Culturally, companies that cultivated design literacy among managers and engineers, and that encouraged interdisciplinary collaboration, successfully reframed design from a supportive function into a core strategic capability for sustainable innovation. This dual evolution, organisational and cultural, emerged as a prerequisite for embedding design as an enduring source of value creation.

A recurring pattern observed across several cases (notably OBM A, D, G, and I) demonstrated that both the timing and duration of design engagement exerted a direct influence on design competitiveness. When design involvement occurred late or superficially, it was reduced to aesthetic styling, resulting in weak differentiation and diminished brand integrity. By contrast, early and continuous design participation generated iterative learning loops between R&D and design teams, strengthened feedback mechanisms, and improved responsiveness to market and user needs.

For firms with limited internal design capability, external design consultancies played a pivotal mediating role, not merely as service providers but as facilitators of knowledge transfer and process learning. Through iterative collaboration, they enabled OBM firms to assimilate design methodologies, progressively internalising design expertise and evolving from outsourcing-based cooperation to co-creative partnerships. This hybrid model of collaboration functioned as an organisational learning mechanism, accelerating the transition towards design-led innovation.

Collectively, the case evidence demonstrated that the institutionalisation of design is not a linear or prescriptive process but rather a cumulative, adaptive, and reflexive phenomenon shaped by organisational learning, contextual negotiation, and process adaptation. Achieving sustainable design integration requires both a structural framework, comprising design evaluation systems and knowledge-sharing mechanisms, and a cultural mindset that embraces experimentation, collaboration, and continuous reflection.

Importantly, the study also revealed a shared limitation across many OBM firms: the lack of design experience, fragmented or incomplete process structures, and the absence of institutional support mechanisms. These constraints prevent design from functioning as a strategic driver and instead relegate it to a secondary, aesthetic role. Consequently, there is an urgent need for a structured and contextually adapted design process framework that can address these organisational and experiential deficiencies, guiding OBM firms towards the systematic internalisation of design.

Chapter 5 establishes that design integration within OBM firms depends upon the co-evolution of structural management and cultural transformation, grounded in experiential learning and reflective adaptation. These findings provide the empirical and theoretical foundation for the subsequent chapter, which develops a comprehensive framework for design process refinement and organisational maturity progression, enabling OBM firms to transition from function-based efficiency to design-driven strategic innovation.

Chapter 6. Discussion & Recommendation

6.1 Introduction

This chapter synthesises the theoretical and empirical findings of the study to analyse how design processes are conceptualised, implemented, and evolved within industrial organisations. Focusing particularly on OBM firms, it integrates insights from the literature review and case analyses of international brands, design agencies, and OBM firms to provide a comprehensive interpretation of how design develops from a functional activity into a strategic organisational capability.

The chapter argues that the CDPs represents not a mere procedural improvement, but a fundamental organisational transformation that integrates creativity, technology, and strategy. Design is no longer confined to a subordinate or aesthetic function within product development; rather, it operates as a cognitive and cultural mechanism that facilitates organisational learning, knowledge accumulation, and innovation alignment.

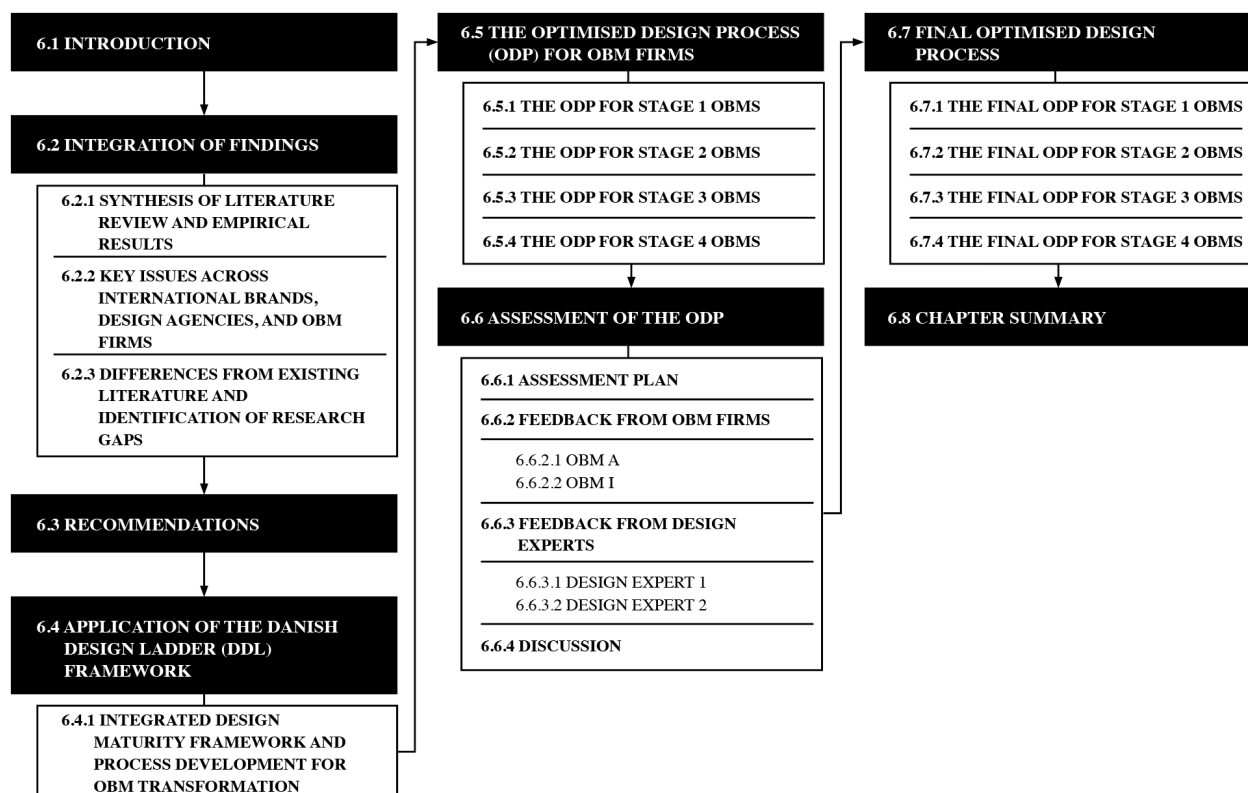
Through a comparative analysis of international brands, design agencies, and OBM firms, the study identifies significant variation in how design is institutionalised across structural, cultural, and strategic dimensions. Global brands demonstrate advanced integration systems grounded in leadership support and cross-functional collaboration, whereas East Asian manufacturing-oriented OBM firms continue to exhibit engineering-dominated hierarchies, fragmented collaboration, and superficial participation in design activities. These contrasts reveal that the maturity of design depends not only on procedural refinement but also on cultural transformation and the alignment of interpretive practices within organisational systems.

The first section, Discussion, critically compares existing design process theories with their application in industrial contexts. Classical process models, such as those proposed by Archer, Pahl & Beitz, Ulrich & Eppinger, and the Design Council, offer procedural rigour and structural clarity but fail to capture the iterative, adaptive, and socially embedded nature of design practice in real industrial settings. On this basis, the study reconceptualises design as a dynamic organisational learning system that bridges strategic intent and operational execution.

The second section, Recommendations, builds upon these theoretical and empirical insights to propose actionable strategies for OBM firms seeking to internalise design as a sustainable innovation capability. Drawing on the Danish Design Ladder, the study presents stage-specific CDP that enable the progressive embedding of design within existing NPD structures. The recommendations emphasise early design involvement, institutionalised cross-functional collaboration, and the establishment of knowledge transfer mechanisms with external partners to strengthen internal capabilities and enhance organisational resilience.

This chapter positions design as both a strategic integrator and a catalyst for organisational learning, bridging the gap between theory and practice. By redefining design as a system of organisational cognition and coordination, it establishes a theoretical and practical foundation for OBM firms to transition from engineering-driven efficiency processes toward design-led innovation systems, thereby enhancing long-term competitiveness and strategic coherence.

Figure 6.1 Overview of the overall structure and procedural flow of this chapter.



[Figure 6. 1: Chapter map]

6.2 Discussion

This chapter integrates theoretical perspectives and empirical findings to examine how design processes are implemented and developed within industrial organisations, with particular attention to OBM firms. It argues that the role of design is shaped by the interaction between organisational structure, culture, and learning capability.

A comparative analysis of international brands, design agencies, and OBM firms highlights differing levels of design maturity. International brands demonstrate systematic integration of design within strategic decision-making and innovation processes, while design agencies exhibit methodological flexibility and collaborative adaptability. In contrast, OBM firms remain constrained by engineering-led hierarchies, limited cross-functional integration, and restricted design autonomy. These differences indicate that design maturity depends less on the adoption of specific process models and more on the organisational conditions that support design integration.

The discussion is structured around three analytical dimensions:

- 1) the divergence between design theory and industrial practice,
- 2) the mechanisms through which design becomes institutionalised, and
- 3) the reconceptualisation of design as an evolving organisational system

6.2.1 Synthesis of literature review and empirical results

The synthesis of literature and empirical findings demonstrates that existing design process models, while theoretically robust, are insufficiently responsive to the contextual conditions of OBM firms.

Rational and engineering-based models (Archer, 1963; Ulrich & Eppinger, 1995; Pahl & Beitz, 1996) emphasise structured problem-solving, documentation, and control. However, empirical evidence from OBM cases indicates that such linear models fail to accommodate the iterative negotiation, cross-functional dependency, and organisational constraints inherent in manufacturing-led environments. Design activities in these firms are often reactive and

confined to downstream stages, reflecting structural limitations previously identified by Bruce and Docherty (1993) and Tsai and Hung (2010). This confirms that procedural clarity alone does not ensure effective design integration in transitional industrial contexts.

In contrast, iterative and human-centred frameworks (Jones, 1970; Lawson, 1990; Design Council, 2006) provide conceptual flexibility but assume a level of organisational maturity that is not present in most OBM firms. The empirical findings reveal that firms transitioning from OEM or ODM models lack the institutional mechanisms, such as cross-functional collaboration, reflective practices, and user-centred orientation, required to operationalise iterative design processes. This results in a gap between theoretical ideals of co-evolution and the practical constraints of industrial production.

Strategic and interpretive perspectives (Buchanan, 1992; Cross, 2000; Borja de Mozota, 2002) are strongly supported by the empirical data. International brands and leading design agencies demonstrate design as an embedded organisational capability that integrates technological feasibility, user insight, and brand strategy. In these contexts, design operates through structured feedback loops, interdisciplinary collaboration, and continuous evaluation. By contrast, OBM firms exhibit fragmented design practices, limited strategic alignment, and dependence on external expertise, indicating that design capability development requires systematic organisational learning rather than isolated project-level improvement.

The findings also substantiate existing literature on design outsourcing and knowledge transfer (Bruce & Morris, 1994; Berends et al., 2011; Erichsen & Christensen, 2013). In OBM contexts, external collaboration produces limited long-term impact when treated as a transactional activity. However, when collaboration involves early-stage co-creation, shared tools, and iterative feedback, it facilitates knowledge internalisation and capability development. This highlights the importance of absorptive capacity and organisational readiness in determining the effectiveness of design partnerships.

Overall, the synthesis indicates that design processes in OBM firms operate as hybrid systems integrating two complementary logics. The structuring logic ensures coordination, accountability, and process clarity across multidisciplinary teams, while the adaptive logic enables learning, iteration, and responsiveness to contextual conditions. Firms that successfully

balance these logics demonstrate higher levels of innovation performance, whereas those relying on a single logic experience either rigidity or strategic ambiguity.

This integrated perspective provides the foundation for the CDP framework developed in this study, positioning design as an evolving organisational learning system rather than a fixed procedural model.

6.2.2 Key issues across international brands, design agencies, and OBM firms

1) Strategic positioning and maturity of design capability

International brands exhibit a high level of design institutionalisation, where design is embedded within strategic planning, product development, and organisational decision-making. In these firms, design functions as a central coordinating mechanism linking brand identity, user experience, and technological development.

In contrast, OBM firms display uneven levels of design maturity. Many remain engineering-dominated, with design introduced at later stages and limited to aesthetic refinement. This restricts design's influence on innovation outcomes and reduces its strategic value. Only a small number of firms demonstrate early-stage design involvement and emerging cross-functional integration, indicating the initial stages of transformation.

Design agencies occupy an intermediary role, providing methodological expertise and facilitating collaboration. However, their impact is contingent upon the client organisation's ability to internalise design knowledge and integrate it into existing structures.

2) Organisational structure and cross-functional coordination

The degree of cross-functional integration between design, engineering, and marketing is a critical determinant of design effectiveness. International brands demonstrate integrated workflows and parallel development processes, where design is involved from early stage and contributes to decision-making across function.

By contrast, OBM firms typically follow sequential and hierarchical processes, where design is excluded from early planning stages. This leads to inefficiencies, reduced innovation potential, and weak alignment between technical and user requirements. Even where design teams exist, their limited authority and late-stage involvement constrain their impact.

Design agencies facilitate collaborative interaction through co-design and iterative prototyping, but structural rigidity within OBM firms often limits the sustainability of these collaborations. This indicates that effective design integration requires organisational restructuring alongside methodological adoption.

3) Cultural attitudes and leadership orientation

Organisational culture and leadership play a decisive role in shaping design integration. International brands demonstrate design-oriented leadership, where design is framed as a strategic and exploratory activity that supports innovation and learning. This fosters a culture of experimentation and iterative refinement.

In OBM firms, leadership tends to prioritise efficiency, predictability, and technical control, limiting the adoption of design-led approaches. Design is often perceived as a cost rather than a value-generating capability. Only when leadership actively supports design as a strategic resource does it begin to achieve organisational legitimacy.

Design agencies highlight the importance of cultural alignment in collaboration. Their ability to deliver meaningful impact depends on whether client organisations are receptive to iterative processes and open knowledge exchange.

4) Design knowledge transfer and learning process

Knowledge transfer emerges as a critical factor differentiating the three organisational contexts. International brands institutionalise design knowledge through structured processes, including documentation, evaluation, and integration into organisational systems.

In contrast, OBM firms lack formal mechanisms for knowledge retention, resulting in limited learning from design activities and continued dependence on external expertise. Design agencies contribute knowledge through collaborative processes, but the sustainability of this transfer depends on internal learning capacity.

These findings support the concept of organisational learning (Argyris & Schön, 1996), indicating that design capability development requires both procedural refinement and transformation of underlying assumptions.

5) Structural synthesis and emerging convergence

The comparative analysis reveals a continuum of design maturity, ranging from execution-focused OBM firms, through collaborative agency-led processes, to fully institutionalised design systems in international brands. This continuum suggests that design capability evolves through iterative learning, organisational adaptation, and integration of internal and external knowledge.

6.2.3 Differences from existing literature and identification of research gaps

This study identifies several limitations in existing design process literature. These limitations and the corresponding contributions of this research are summarised in Table 6.1.

Table 6. 1: Theoretical gaps and contributions of the study

Theoretical Focus	Limitations in Existing Literature	Empirical Findings (from this study)	Theoretical Contribution of this Study
1. Nature of the design process	Existing models (Archer, Pahl & Beitz, Ulrich & Eppinger, Design Council) conceptualise design as a linear, procedural system focused on problem-solving.	OBM firms exhibit iterative, adaptive, and socially negotiated design practices shaped by organisational culture and hierarchy.	Reframes design as a dynamic, context-sensitive organisational learning system evolving with maturity and cultural adaptation.
2. Organisational integration	Design treated as a standalone methodological entity; limited attention to leadership, hierarchy, and cross-functional integration.	Design effectiveness depends on system-wide alignment among design, engineering, and strategy, mediated by leadership cognition.	Extends design theory to a socio-organisational model that embeds design within decision-making and institutional learning structures.
3. Collaboration and knowledge transfer	Collaboration with design agencies viewed as	OBM–agency collaborations are	Introduces relational learning and absorptive

	transactional and symmetric knowledge exchange.	asymmetrical; knowledge transfer limited by absorptive capacity and cultural misalignment.	capacity as critical mechanisms for sustainable design collaboration.
4. Industrial and cultural context	Most design process theories developed in mature Western/Japanese economies with institutionalised design systems.	OBM firms operate under transitional, hybrid conditions, efficiency-driven structures with emerging design culture.	Fills contextual and geographic gap by theorising design process development in transitional East Asian manufacturing contexts.
5. Cognitive role of design	Design conceptualised primarily as creative practice or management tool.	Mature design organisations treat design as a cognitive mode for framing complexity and uncertainty.	Positions design as a form of organisational cognition, linking DBR with reflective sensemaking and strategic decision-making.

First, existing models conceptualise design as a structured and linear process, whereas empirical findings demonstrate that design operates as a dynamic and context-dependent system shaped by organisational, cultural, and collaborative factors.

Second, design is often treated as a procedural activity rather than an organisational capability. This study shows that effective design integration requires alignment across organisational structure, culture, and leadership, extending beyond process optimisation.

Third, collaboration with design agencies is typically conceptualised as a transactional exchange. However, empirical findings indicate that it functions as a relational learning process dependent on absorptive capacity and organisational openness (Cohen & Levinthal, 1990).

Fourth, existing theories are largely based on mature industrial contexts and do not adequately reflect transitional OBM environments, where design capability develops incrementally through stages of learning and adaptation.

Finally, design is rarely conceptualised as a form of organisational cognition. The findings demonstrate that advanced firms use design as a framework for interpreting complexity, aligning strategy, and enabling innovation (Buchanan, 1992).

6.3 Recommendations

This chapter translates the study's theoretical and empirical findings into concise, actionable guidance for embedding design as a core organisational capability within OBM firms. It

identifies persistent obstacles, such as structural misalignment, late design involvement in NPD, and transactional use of external agencies, that limit design's strategic impact in manufacturing environments.

The proposed recommendations bridge theory and practice by outlining how firms can internalise design within decision-making, establish cross-functional collaboration, and build the absorptive capacity to work effectively with external partners. The focus is on implementing gradual, realistic change aligned with each firm's design maturity and NPD phase.

Three priorities define the framework:

- 1) granting design early and structured influence in NPD with executive support;
- 2) formalising collaboration among design, engineering, and marketing from the problem-definition stage; and
- 3) developing long-term, knowledge-sharing partnerships with design consultancies.

Guided by the DDL, the recommendations present stage-specific pathways that help OBM firms evolve from styling-focused activities to process-level integration and, ultimately, to design as a strategic driver. By aligning structural systems with cultural change, firms can transform design from a peripheral function into a sustained engine of innovation, competitiveness, and organisational learning.

6.4 Application of the DDL framework

The comparative case analyses reveal persistent structural and procedural barriers limiting the integration of design within OBM firms. These include late-stage design involvement, engineering-dominant decision-making, and reliance on external consultancies without internal capability development. As a result, design is often applied symbolically rather than systemically, primarily confined to aesthetic refinement with limited influence on strategic planning. This aligns with Bruce and Bessant's (2002) characterisation of early-stage design adoption, where design exists but does not function as a driver of innovation.

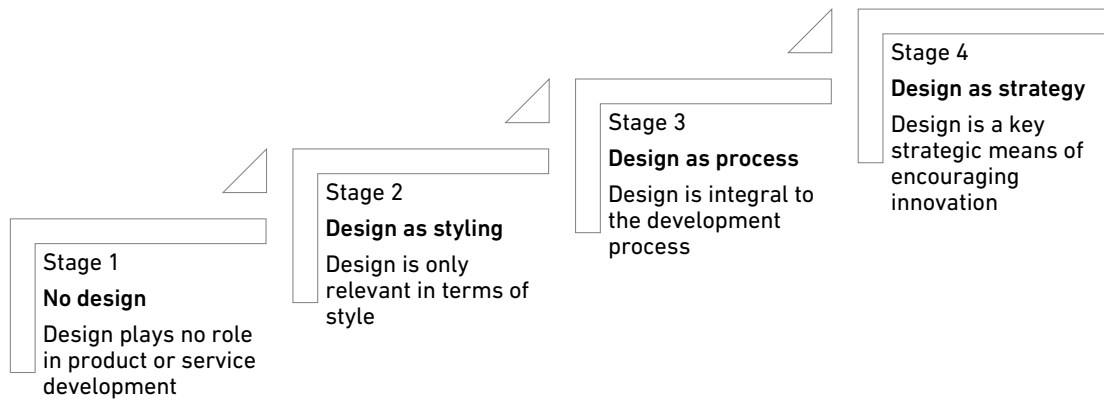


Figure 6. 2: The Danish Design Ladder (Adapted from Danish Design Centre, 2001)

Within this context, the DDL (Danish Design Centre, 2001) provides a robust framework for evaluating design maturity. It conceptualises progression across four stages, no design, design as styling, design as process, and design as strategy, each reflecting increasing levels of organisational learning, integration, and strategic alignment (Borja de Mozota, 2003; Erichsen & Christensen, 2013). The DDL thus functions as both a diagnostic and developmental model for assessing and advancing design capability.

Distribution of OBM firms along the DDL framework

The positioning of OBM firms A–J (Table 6.2) indicates that most remain concentrated in Stages 1 and 2, reflecting limited institutionalisation of design. Only a small number of exhibit transitional characteristics of Stage 3, while none reach Stage 4, where design operates as a strategic organisational capability.

Table 6. 2: Integrating the Danish Design Ladder Framework: A Stage-Based Roadmap for OBM Design Maturity

Stage of DDL	OBM firms	Summary Characteristics
Stage 1 – No Design	OBM F, G, and J	No in-house design or late-stage cosmetic input; design is non-strategic.
Stage 2 – Design as Styling	OBM A, B, C, D, E, H, and I	Design used for aesthetics or packaging; limited internal teams; no early-stage involvement.

Stage 3 – Design as Process	OBM A (borderline) and E	External design team collaborates across phases; early involvement but still under engineering control.
Stage 4 – Design as Strategy	None	No evidence of design driving business or corporate innovation.

At Stage 1 (No Design), firms such as OBM F, G, and J demonstrate minimal engagement, with no internal design capability and reliance on engineering-led decision-making. Design, when present, is reactive and unstructured.

At Stage 2 (Design as Styling), firms including OBM A, B, C, D, H, and I recognise design but primarily apply it to visual refinement. Design involvement remains sequential and subordinate to engineering processes, limiting its contribution to innovation.

A transitional position towards Stage 3 (Design as Process) is observed in OBM A and E, where design begins to participate in early-stage activities such as ideation and user research. However, integration remains constrained by existing organisational structures.

No firm fully achieves Stage 4 (Design as Strategy), where design is embedded in leadership, decision-making, and innovation systems.

Interpretation and implications

The distribution highlights that design maturity in OBM firms is uneven and constrained by structural and cultural factors. Progress is often incremental and dependent on external collaboration rather than internal capability development. This supports the argument that design maturity is determined not by firm size but by the timing, authority, and integration of design within organisational systems (Bruce & Bessant, 2002).

The case of OBM J illustrates this limitation, where strong engineering capability does not translate into innovation due to the absence of design integration. This reinforces Buchanan (1992) and Cross (2007), who emphasise that innovation requires the integration of design as a cognitive and strategic capability rather than reliance on technical expertise alone.

Accordingly, the DDL functions not only as an evaluative framework but as a roadmap for capability development (see Table 6.3). Progression requires both procedural and cultural

transformation, including the development of design literacy, cross-functional collaboration, and leadership alignment (Best, 2006).

Three interrelated shifts are required:

- organisational learning, integrating design knowledge into NPD processes
- leadership alignment, recognising design as a strategic investment (Borja de Mozota, 2003)
- systemic integration, embedding design within core organisational functions (Erichsen & Christensen, 2013)

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- leadership alignment, recognising design as a strategic investment (Borja de Mozota, 2003)
- systemic integration, embedding design within core organisational functions (Erichsen & Christensen, 2013)

Table 6. 3: Proposed Stage-Based Process of Design Maturity for OBM Firms

Stage of DDL	Design role and organisational focus	Representative OBM firms
Stage 1 – No Design	Design is absent or incidental. Product form and user interaction are determined entirely by engineering. No internal design staff or design literacy.	OBM F, G, and J
Stage 2 – Design as Styling	Design is outsourced to external consultancies and limited to visual or cosmetic improvement. Focus on CMF, packaging, and form aesthetics. Design remains reactive and sequential.	OBM A, B, C, D, E, H, and I
Stage 3 – Design as Process	Design becomes partially integrated into the NPD process. Cross-functional collaboration between design and engineering begins to emerge. User testing and concept iteration are introduced.	OBM A (borderline) and E
Stage 4 – Design as Strategy	Design is institutionalised as a strategic capability embedded across planning, marketing, and R&D. It informs decision-making, branding, and innovation. No OBM firm has yet reached this stage, though OBM D shows transitional tendencies.	None

The application of the DDL demonstrates that design maturity is not linear but context-dependent, shaped by organisational learning and adaptation. The Stage-Based Process of Design Maturity (Table 6.3) conceptualises this progression as an evolutionary and cumulative process through which firms internalise design from a peripheral activity to an embedded strategic capability.

6.4.1 Integrated design maturity framework and process development for OBM transformation

The application of the DDL functions not only as a diagnostic tool for assessing design maturity but also as a developmental roadmap for guiding OBM firms toward design-led transformation. The DDL delineates four progressive stages, no design, design as styling, design as process, and design as strategy, each representing increasing levels of organisational capability, cultural adaptation, and managerial integration (Danish Design Centre, 2001). Progression across these stages requires not merely procedural improvement but a fundamental reorientation in how design is perceived and operationalised as a strategic resource.

Empirical research supports this trajectory. Doherty et al. (2014) demonstrate that advancement in design maturity is driven by iterative organisational learning, leadership commitment, and

the institutionalisation of reflective design practices. This aligns with the findings of this study, which show that OBM firms can transition toward innovation-led models when design becomes embedded within managerial systems and decision-making structures rather than remaining a peripheral activity.

To operationalise this transition, the study aligns the four DDL stages with six canonical phases of the NPD process, idea generation, concept development, design and engineering, prototyping and testing, production readiness, and market launch (Figure 6.3). This alignment establishes a structured yet adaptable pathway through which design capability can be incrementally integrated without disrupting existing production systems. It enables a gradual shift from late-stage aesthetic refinement toward early-stage conceptual involvement and, ultimately, strategic influence over innovation processes.

DDL NPD	STAGE 1: No Design	STAGE 2: Design as Styling	STAGE 3: Design as Process	STAGE 4: Design as Strategy
STEP 1 IDEA GENERATION	- No design involvement - Engineering-only ideation	- Design added after ideation - Surface enhancements only	- Design joins early - Insight based exploration starts	- Design defines opportunity - Insights drive direction
STEP 2 CONCEPT DEVELOPMENT	- No design input - Function-focused concepts	- Design follows concept - Form, colour, packaging only	- Design shapes concept - Moodboards, user journeys used	- Design leads vision - Speculative & future focus
STEP 3 DESIGN & ENGINEERING	- Engineering-driven specs - No form/function balance	- No UX/UI planning - Design beautifies output	- Integrated UX/UI workflows - Design supports PRD building	- Design shapes system - Aligns teams and decisions
STEP 4 PROTOTYPING & TESTING	- Testing by engineers only - No UX focus	- Looks refined, not tested - Low user feedback integration	- Testing involves design - Scenario-based iteration applied	- Co-creation & ethnography - Rapid cycles led by design
STEP 5 PRODUCTION PREPARATION	- Function-based production - No visual refinement	- Design polishes hardware - No influence on production	- Design standards guide specs - Design supports assembly	- Design drives innovation - Governance ensures alignment
STEP 6 MARKET LAUNCH	- Launch without design - Only technical messaging	- Marketing assets designed - Product stays engineering -led	- Brand experience mapped - Design ensures consistency	- Omnichannel strategy - Design = executive function

Figure 6. 3: NPD Process × Design Ladder Framework

Design maturity in OBM firms should therefore be understood not as a fixed organisational state but as a dynamic process of systemic learning and cultural transformation. The interaction between external knowledge exchange and internal capability development enables design to evolve from a functional activity into an institutionalised organisational capability that supports sustained innovation and competitive differentiation (Bruce & Bessant, 2002; Borja de Mozota, 2003; Erichsen & Christensen, 2013).

Building on this logic, Figure 6.4 maps OBM firms A–J onto the DDL framework, illustrating how variations in organisational structure, leadership orientation, and collaboration practices correspond to different levels of design maturity.

DDL NPD	STAGE 1: No Design	STAGE 2: Design as Styling	STAGE 3: Design as Process	STAGE 4: Design as Strategy
	Pre-formation (OBM F, G, J)	Styling (OBM A, B, C, D, H, I)	Process (OBM A – borderline, E)	Strategy (None)
STEP 1 PLANNING	- Product ideas generated by R&D or clients - No design involvement - Innovation defined by technical feasibility	- Design input driven by market trend observation - External consultancies occasionally inform styling directions - Still reactive	- Cross-functional ideation involving design, R&D, and marketing - User research begins informing opportunity framing	-
STEP 2 CONCEPT DEVELOPMENT	- No formal design role - Form and usability determined by engineers	- Design enters post-engineering for aesthetic or CMF enhancement - Minimal user insight	- Early design–engineering co-definition of user needs - Iterative concept mapping and experience modelling	-
STEP 3 SYSTEM-LEVEL DESIGN	Sequential hand-off to external styling or package vendor after technical design is fixed	- Partial co-development - Design adapts to engineering constraints - Minimal iteration	- Concurrent development between design and R&D - Frequent design review cycles and prototype refinements	-
STEP 4 DETAIL DESIGN	- Prototype evaluation limited to mechanical performance - No user or design validation	- Visual mock-ups reviewed for form quality - User testing rare	- Design-led user testing and usability evaluation embedded in NPD cycles - Iterative improvement	-
STEP 5 TESTING AND REFINEMENT	- Design adjusted only for manufacturability - Aesthetic intent lost during transition	- Late-stage CMF and surface review - Limited coordination	- Joint design–engineering validation of manufacturability and design fidelity - Documented processes	-
STEP 6 PRODUCTION RAMP-UP	- Launch managed by engineering and sales teams - Design absent	- Packaging, interface, and marketing visuals outsourced - Low coherence	- Design contributes to branding, manuals, and marketing collateral - Ensures coherent customer touchpoints	-

Figure 6. 4: NPD Process × DDL (Revised for OBM Firms A–J)

At Stage 1 (No Design) represented by OBM F, G, and J, product development is dominated by engineering logic, where innovation is equated with technical optimisation rather than user-centred value creation. Design engagement is either absent or limited to superficial aesthetic modification. These firms exhibit minimal design literacy and lack formalised processes. The initial step toward design integration involves reframing problem definition to include human factors, usability, and emotional experience. As emphasised by Sunley, Pinch, Reimer, and Macmillen (2008), cross-sector collaboration between creative and manufacturing domains facilitates tacit knowledge transfer and enhances absorptive capacity for design. At this formative stage, external design consultancies can act as translators, introducing empathy-driven ideation, contextual research, and iterative learning to familiarise engineering teams with design reasoning.

At Stage 2 (Design as Styling) encompassing OBM A, B, C, D, H, and I, design is formally acknowledged but functionally constrained to the post-engineering stages of NPD. Design activity typically centres on visual refinement, colour, material, finish (CMF), and brand expression. While the aesthetic and symbolic dimensions of design are recognised, workflows remain sequential and technology-driven. Progression to the next stage requires repositioning design from a late-stage enhancement activity to an early-stage collaborative process in which designers participate in conceptual framing alongside engineers. Managerial alignment is critical at this juncture; targeted training and awareness programmes can cultivate a shared understanding of design's strategic objectives, thereby reducing communicative and cultural barriers that impede integration (Bruce & Bessant, 2002).

At Stage 3 (Design as Process) observed in OBM A (borderline) and E, design attains operational integration within the NPD system. These firms engage in iterative prototyping, user testing, and cross-functional collaboration among design, R&D, marketing, and production teams. Design contributes not only to form and usability but also to problem framing and experience evaluation. Nonetheless, design remains procedural rather than fully strategic. Advancement beyond this level requires the institutionalisation of design management systems supported by measurable performance indicators linking design activities to innovation outcomes (Bruce & Bessant, 2002). External partnerships must also evolve into strategic alliances that co-develop brand narratives, service frameworks, and holistic user

experience strategies, transforming design from a functional contributor into an enduring organisational capability.

At Stage 4 (Design as Strategy) a level not yet fully realised among the OBM firms, though OBM D demonstrates early indicators—design becomes an organisation-wide capability embedded within leadership, vision, and culture. At this level, design functions as a strategic integrator that informs scenario planning, foresight, and innovation strategy. It acts as a connective mechanism linking technological capability, brand identity, and user experience, thereby reinforcing organisational learning and strategic coherence (Borja de Mozota, 2003; Erichsen & Christensen, 2013). External design agencies, rather than serving as service providers, operate as co-strategists engaged in executive-level initiatives and long-term transformation programmes.

To conclude, the integrated design maturity framework reveals that the progression of OBM firms along the DDL is neither linear nor automatic. It requires deliberate organisational learning, leadership advocacy, and sustained cultural transformation. By aligning design processes with strategic objectives and embedding them within core management systems, OBM firms can evolve from design as styling to design as strategy, establishing design as a cognitive, developmental, and strategic resource fundamental to sustainable innovation and global competitiveness.

6.5 The CDP for OBM firms

6.5.1 The CDP for Stage 1 OBMs

Stage 1 OBM firms, positioned within the “No Design” phase of the Danish Design Ladder, are typically characterised by engineering-dominant development structures where innovation is defined by technical performance, cost control, and production efficiency rather than user experience. In such environments, design is absent or limited to peripheral functions such as packaging or marketing support. Firms such as OBM F, G, and J illustrate this condition, possessing strong technological expertise but lacking internal design capacity, structured user insight, or systematic collaboration with design professionals.

The CDP for Stage 1 OBM provides a pragmatic and accessible framework that gradually introduces design into engineering workflows without disrupting established systems. Rather than treating design as a creative or aesthetic layer, it reframes it as a visual and evidence-based decision-making tool. The process aligns with existing NPD structures and consists of nine progressive stages that embed design checkpoints within familiar engineering phases, from problem clarification and concept exploration to manufacturability review and post-launch learning.

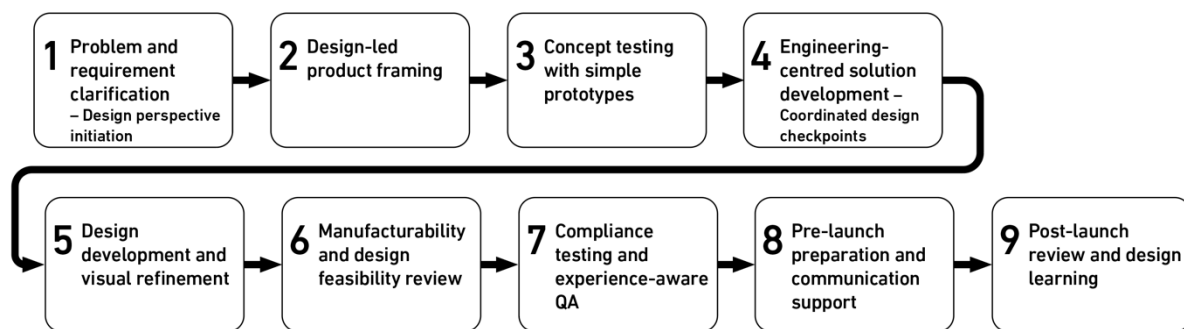


Figure 6. 5: CDP for OBM Firms at Stage 1 of the DDL (No Design)

CDP for OBM firms at Stage 1 of the Danish Design Ladder (Figure 6.5)

- Step 1. Problem and requirement clarification – Design perspective initiation
- Step 2. Design-led product framing
- Step 3. Concept testing with simple prototypes
- Step 4. Engineering-centred solution development – Coordinated design checkpoints
- Step 5. Design development and visual refinement
- Step 6. Manufacturability and design feasibility review
- Step 7. Compliance testing and experience-aware QA
- Step 8. Pre-launch preparation and communication support
- Step 9. Post-launch review and design learning

At the early steps, design is applied as an interpretive lens to visualise user contexts and functional requirements. Simple sketching and low-fidelity prototypes serve as entry points for communication and empirical testing. These activities allow engineering teams to begin incorporating user-related considerations and reduce miscommunication early in development. Subsequent steps introduce design review loops within CAD and component discussions,

enabling small but consistent visual oversight that strengthens aesthetic coherence and ergonomic alignment without increasing cost or complexity.

Later steps emphasise design–engineering collaboration in manufacturability and quality assurance. Design validation is embedded within EVT–DVT–PVT testing, aligning experiential and technical evaluation under a unified quality framework. User-oriented assessments such as heuristic analysis or basic ergonomic checks are integrated with minimal resources, creating tangible pathways for firms to adopt basic design-informed review practices.

The final steps extend design influence beyond product realisation to communication and learning. Design supports packaging, manuals, and digital presentation, ensuring consistency in customer experience, while post-launch reviews capture user feedback and operational lessons. These feedback mechanisms lay the foundation for initial knowledge accumulation and reflective learning, crucial for firms with limited design literacy.

The CDP’s theoretical foundation draws on Sunley et al.’s (2008) Knowledge Exchange Loop, which explains how external expertise can evolve into internalised organisational capability. For Stage 1 OBMs, external design agencies act as knowledge transmitters, helping translate design thinking into engineering contexts. Repetition and incremental adaptation allow these practices to become habitual, moving firms from “no design” to “design awareness.”

The CDP functions as both a practical implementation process and a cultural learning framework. Its effectiveness lies in incremental, credible interventions, the first user scenario visualisation, the first 3D-printed mock-up, the first usability check, that progressively normalise design within engineering environments. Through these actions, Stage 1 OBMs establish the cognitive and procedural foundation for initial design awareness and limited integration, evolving from reactive manufacturing efficiency to early-stage design-informed improvement. This marks the first step toward advancing up the DDL, preparing the foundation for subsequent design development rather than achieving design-driven competitiveness.

Figure 6.6 presents a summarised description of the CDP stages observed in Stage 1 OBM firms, outlining the corresponding design activities and the anticipated outcomes at each phase.

Step	Description	Design Activities	Expected Outcomes
STEP 1 Problem and Requirement Clarification	Define technical and market objectives while framing design perspectives	- Map stakeholders and user environments - Visualise R&D specifications - Enable cross-functional collaboration	Establish a shared understanding of user context and design relevance in early NPD phases
STEP 2 Design-led product framing	Convert engineering-oriented requirements into conceptual	- Create preliminary sketches and 2D layouts - Run scenario-based framing workshops - Use mood boards to align aesthetic and ergonomic intent	Cross-departmental alignment on functional and visual direction
STEP 3 Concept testing with simple prototypes	Validate functional and ergonomic feasibility with low-fidelity prototypes	- Build basic mock-ups using foam, paper, or 3D printing - Conduct quick usability checks - Gather visual and interaction feedback from teams	Identify design and usability issues early while improving communication
STEP 4 Engineering-centred solution development	Integrate design feedback in CAD and engineering reviews	- Hold joint reviews of design and technical models - Refine form and layout for consistency - Assess ergonomic and assembly constraints	Achieve stronger technical-aesthetic balance and better team decisions
STEP 5 Design development and visual refinement	Refine form, proportion, and surface detail through technical validation	- Create refined digital visuals or foam prototypes - Define CMF (colour, material, finish) options - Conduct internal reviews with cross-functional teams	Ensure clear communication of design intent and stronger internal alignment
STEP 6 Manufacturability and design feasibility review	Align design intent with production constraints	- Collaborate on tooling feasibility and tolerance checks - Validate materials and finishes under production conditions - Document CMF guidelines for production teams	Ensure consistency between design concept and manufacturable outcome
STEP 7 Compliance testing and experience-aware QA	Integrate user validation into the quality assurance process	- Conduct usability audits (e.g., grip comfort, visibility, tactile feedback) - Incorporate user observation data into QA documentation - Cross-review QA findings with design and engineering teams	Enhance product usability and reliability through early detection of user experience issues
STEP 8 Pre-launch prep and communication support	Extend design involvement to branding, packaging, and launch activities	- Design packaging and visual manuals aligned with the overall design language - Develop marketing imagery and interface visuals - Ensure consistency across all communication materials	Deliver a cohesive product-brand experience and improved launch alignment
STEP 9 Post-launch review and design learning	Capture and embed post-market feedback for future improvement	- Collect user feedback and post-launch data - Hold internal workshops to assess design effectiveness - Update design documentation for knowledge sharing	Foster continuous learning and build an internal design knowledge base

Figure 6. 6: CDP for Stage 1 OBM

6.5.2 The CDP for Stage 2 OBM's

Stage 2 OBM firms occupy a transitional position on the DDL, where design emerges as a structured yet still operationally limited function. At this level, design contributes to product refinement and differentiation but remains peripheral to early-stage strategy. Firms such as OBM A, B, C, D, H, and I exemplify this condition: while acknowledging the value of design, their development processes continue to be engineering-led, with design introduced only after key technical parameters are defined.

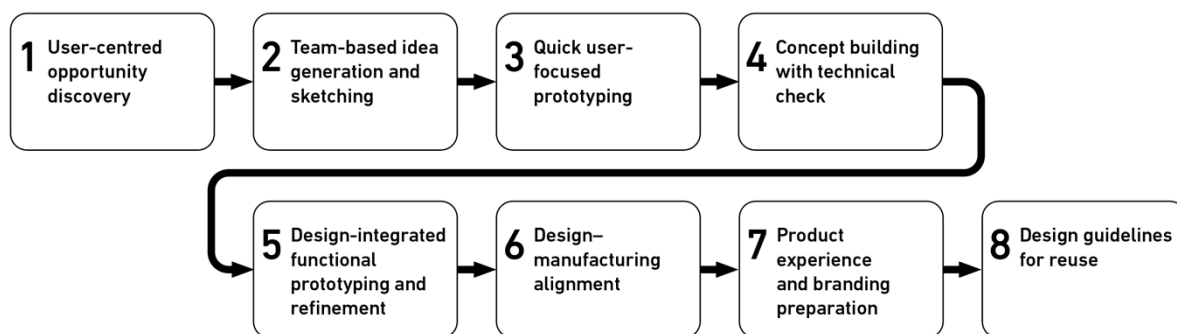


Figure 6. 7: CDP for OBM Firms at Stage 2 of the DDL (Design as Styling)

The CDP for Stage 2 OBM's provides a structured roadmap progressively embedding design into cross-functional collaboration without disrupting existing engineering workflows. The process comprises eight iterative steps that extend design participation across the product development cycle:

CDP for OBM Firms at Stage 2 of the Danish Design Ladder (Figure 6.7)

- Step 1. User-centred opportunity discovery
- Step 2. Team-based idea generation and sketching
- Step 3. Quick user-focused prototyping
- Step 4. Concept building with technical check
- Step 5. Design-Integrated Functional Prototyping and Refinement
- Step 6. Design-manufacturing alignment
- Step 7. Product experience and branding preparation
- Step 8. Design guidelines for reuse

In the early steps, user-centred opportunity discovery and team-based ideation position design as a tool for interdisciplinary communication. Firms begin incorporating user research and trend analysis into planning, supporting alignment between technical feasibility and user relevance. Collaborative sketching workshops establish a shared visual language across design, engineering and marketing functions.

The middle steps, focused on concept development, prototyping, and feasibility evaluation, extend design beyond surface-level refinement toward an evaluative role. Simple prototypes and mock-ups are used to assess usability, ergonomics, and aesthetic direction. Design-engineering review sessions ensure technical viability while maintaining design intent, shifting the process from sequential handover toward coordinated development.

The later steps, design–manufacturing alignment, integrated product experience, and branding, extend design’s influence downstream. By involving manufacturing teams in surface finishing, assembly, and quality evaluation, firms establish consistency between visual quality and production efficiency. Design also begins to shape customer-facing elements such as packaging, interface, and storytelling, gradually extending design considerations across multiple development touchpoints.

The final step, documentation and design knowledge consolidation, converts tacit learning into organisational capital through process records, pattern libraries, and CMF databases. This systematic documentation builds the foundation for continuous learning and scalable design capability.

Conceptually, the Stage 2 CDP represents the transition from design as execution to design as coordination. It introduces small but cumulative procedural changes that normalise design participation across departments. Consistent with Mozota’s (2006) view of design maturity as a convergence of design management and cross-functional learning, this process enables design to evolve from decorative intervention toward a more coordinated and early-engaged role within product development, without yet achieving full process integration.

For OBM A, B, C, D, H, and I, the Stage 2 CDP functions as a bridge between engineering efficiency and enhanced design integration. By embedding design checkpoints and feedback loops within existing NPD structures, firms begin to strengthen communication, support

iterative development, and improve overall product coherence. Ultimately, this process establishes both the structural and cultural foundation for progression toward Stage 3 maturity, where design becomes more systematically embedded within development processes and cross-functional collaboration.

Figure 6.8 presents a summarised description of the CDP stages observed in Stage 2 OBM firms, outlining the corresponding design activities and the anticipated outcomes at each phase.

Step	Description	Design Activities	Expected Outcomes
STEP 1 User-centred opportunity discovery	Shift product development from technology- to user-driven focus	- Conduct contextual interviews and behavioural mapping - Analyse user journeys and pain points - Translate insights into opportunity frameworks with designers and engineers	Align R&D objectives with real user needs and contexts
STEP 2 Team-based idea generation and sketching	Initiate collaborative visual ideation across engineering, marketing, and design	- Hold ideation workshops with engineers and external designers - Create concept sketches and quick models - Develop visual narratives linking function and emotion	Foster cross-departmental alignment and early visual coherence
STEP 3 Quick user-focused prototyping	Validate early ideas through rapid, tangible experimentation bridging design and technical intent	- Build low-fidelity prototypes (foam or 3D prints) - Perform quick usability checks - Gather feedback from internal and external reviewers	Enable early detection of design–function gaps and promote iterative learning
STEP 4 Concept building with technical check	Integrate design proposals with technical feasibility through structured reviews	- Hold joint assessments between design and engineering - Evaluate material and CMF options - Align aesthetic intent with mechanical constraints	Achieve balanced design–engineering decisions and prevent late-stage styling changes
STEP 5 Design-integrated functional prototyping & refinement	Implement iterative refinement through real-time design–engineering collaboration	- Embed designers in prototype validation - Adjust form, surface, and interface using usability data - Develop parallel prototypes for design and engineering	Improve product coherence and optimise function and experience
STEP 6 Design–manufacturing alignment	Reconcile conceptual design with manufacturability for production consistency	- Work with tooling and production engineers - Define CMF standards and assembly constraints - Verify aesthetic and tactile quality in production	Ensure accurate design translation and balanced cost–quality output
STEP 7 Product experience and branding preparation	Extend design contribution to communication and user onboarding	- Create packaging and visual manuals aligned with brand identity - Integrate interface visuals and tone-of-voice guidelines - Align launch communication with product design language	Ensure a cohesive product–brand identity and seamless user experience at launch
STEP 8 Design guidelines for reuse	Institutionalise design learning through documentation and capability building	- Compile design rationale and CMF records - Establish internal design archives and iteration logs - Hold reflection sessions for knowledge transfer	Build organisational design literacy and reduce reliance on external partners

Figure 6. 8: CDP for Stage 2 OBM

6.5.3 The CDP for Stage 3 OBMs

At Stage 3 of the Danish Design Ladder, design transitions from a downstream or supportive role to a core procedural system embedded across the entire NPD lifecycle. Firms at this level

recognise design not as surface styling but as a structured integrative method that links technology, user experience, and development processes. OBM A and OBM E exemplify this stage, representing firms that are actively institutionalising design as a repeatable and measurable organisational capability.

The CDP for Stage 3 establishes a framework in which design becomes a procedural bridge between departments, supporting the translation of user and development requirements into coordinated actions. It embeds design within management, engineering, and production workflows, ensuring continuity, accountability, and learning.

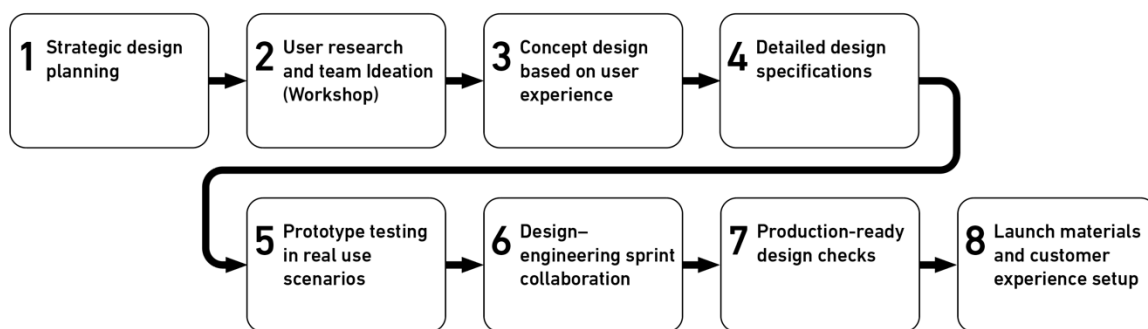


Figure 6. 9: CDP for OBM Firms at Stage 3 of the DDL (Design as Process)

CDP for OBM Firms at Stage 3 of the Danish Design Ladder (Figure 6.9)

- Step 1. Strategic design planning
- Step 2. User research and team Ideation (Workshop)
- Step 3. Concept design based on user experience
- Step 4. Detailed design specifications
- Step 5. Prototype testing in real use scenarios
- Step 6. Design-engineering sprint collaboration
- Step 7. Production-ready design checks
- Step 8. Launch materials and customer experience setup

The process begins with structured design planning, where design supports the alignment of user requirements, technical constraints, and development objectives. Design participates in defining experience-related criteria and evaluation metrics, creating visual roadmaps that guide development activities. In firms like OBM E, design workshops formalise this connection

between brand experience and performance metrics, while OBM A uses similar exercises with external partners to shift project goals toward user-centred priorities.

The next steps, user research, ideation, and experience-led concept development, institutionalise human-centred design as part of NPD. Cross-functional workshops involving design, engineering, and marketing teams transform user insight into actionable opportunity areas. OBM E has formalised these through structured experience mapping and prototype simulation, while OBM A has begun implementing observation and storyboarding practices that support internal capability development. These activities strengthen mutual literacy between designers and engineers, fostering empathy and collaborative understanding.

The core procedural stages, design specification, prototype testing, and sprint collaboration, represent the operational heart of Stage 3 maturity. Design and engineering co-develop solutions through iterative validation, sprint-based reviews, and shared decision-making. OBM E's weekly sprint process exemplifies this collaboration, ensuring that form, material, and interface decisions are continuously tested and refined. OBM A, in earlier transition, has adopted prototype review loops that align design intent with technical feasibility. This cyclical workflow transforms design from a linear input to a feedback-driven, co-creative process.

In the final steps, production-ready design checks and customer experience setup, design becomes a quality and brand assurance mechanism. OBM E employs design-led QA benchmarks, CMF libraries, and internal manuals to sustain fidelity from prototype to production. OBM A is developing similar practices on a smaller scale, reflecting the early stages of institutional design learning.

Conceptually, this stage reflects what Mozota (2006) defines as design management as coordination, where design functions as a cognitive infrastructure connecting strategy, execution, and feedback. By formalising design processes and documentation, firms like OBM E convert tacit design experience into codified organisational knowledge.

The Stage 3 CDP thus marks the organisational consolidation of design maturity. It bridges Bruce and Bessant's (2002) "integration gap" between technological innovation and user experience, positioning design as a procedural competence that drives innovation orchestration.

Firms at this level gain measurable benefits, greater efficiency, faster iteration cycles, improved communication, and enhanced traceability of design intent.

While OBM E exemplifies near-complete process-level integration, OBM A illustrates the transitional learning required for cultural and structural alignment. Collectively, these firms demonstrate that advancing from Stage 2 to Stage 3 requires more than procedural change: it demands design-led sense-making, where design becomes an organisational logic for decision-making, coordination, and continuous innovation.

Figure 6.10 presents a summarised description of the CDP stages observed in Stage 3 OBM firms, outlining the corresponding design activities and the anticipated outcomes at each phase.

Step	Description	Design Activities	Expected Outcomes
STEP 1 Strategic design planning	Establish long-term product and brand vision by integrating design strategy early with business and technical goals	- Hold strategic design workshops with management and R&D - Define UX objectives and experience KPIs - Create brand–experience alignment maps and design charters	Foster shared strategic direction and clear articulation of design intent and business value
STEP 2 User research and team ideation	Identify latent user needs and frame innovation opportunities through cross-disciplinary research	- Conduct ethnographic and contextual studies - Run team-based ideation and empathy mapping - Facilitate co-creation with designers, engineers & marketing	Build shared user insight and strengthen human-centred design culture
STEP 3 Concept design based on user experience	Translate research insights into product concepts linking function, usability, and emotion	- Develop journey maps, personas, and low-fidelity prototypes - Create conceptual sketches and storyboards - Gather early user feedback	Achieve early concept alignment and balance design with technology
STEP 4 Detailed design specifications	Define manufacturable design details with R&D and production teams	- Develop annotated CAD models and CMF documentation - Build shared design repositories and component libraries - Set cross-team validation checkpoints	Ensure technical–aesthetic coherence and smooth transition to production
STEP 5 Prototype testing in real use scenarios	Validate prototypes in real-world settings to ensure experiential and functional integrity	- Build mid- or high-fidelity prototypes - Conduct contextual usability tests with target users - Analyse emotional and behavioural responses	Support evidence-based refinement and deepen user empathy
STEP 6 Design–engineering sprint collaboration	Replace sequential handovers with agile, iterative co-creation between design and engineering	- Embed designers in engineering sprints - Hold daily co-creation and rapid iteration sessions - Document design rationale on visual boards	Enhance design ownership, agility, and cross-team communication while reducing lead time
STEP 7 Production-ready design checks	Ensure design intent is maintained through scaling and pre-production	- Join pilot builds and validate CMF - Conduct aesthetic and tactile quality audits - Align QA standards with design specifications	Maintain design fidelity and consistency from prototype to mass production
STEP 8 Launch materials and customer experience setup	Extend design responsibility to customer touchpoints and brand communication	- Develop unboxing, onboarding, and interface experiences - Create unified brand and design manuals - Produce marketing and digital assets consistent with product identity	Deliver an integrated brand–product experience and reinforce emotional continuity at launch

Figure 6. 10: CDP for Stage 3 OBMs

6.5.4 The CDP for Stage 4 OBMs

At Stage 4 of the Danish Design Ladder, design transcends its functional and aesthetic roles to become an organisational strategy that drives long-term innovation, cultural alignment, and

value creation. At this highest level of maturity, design functions as a strategic integrator, a unifying capability that connects corporate vision, technology, and user experience to form a coherent system of decision-making. Although no OBM firm in this study has fully reached this stage, the CDP for Stage 4 provides a theoretical framework illustrating what complete design maturity entails: an organisation where design systematically integrates vision, innovation, and organisational learning across all levels of operation.

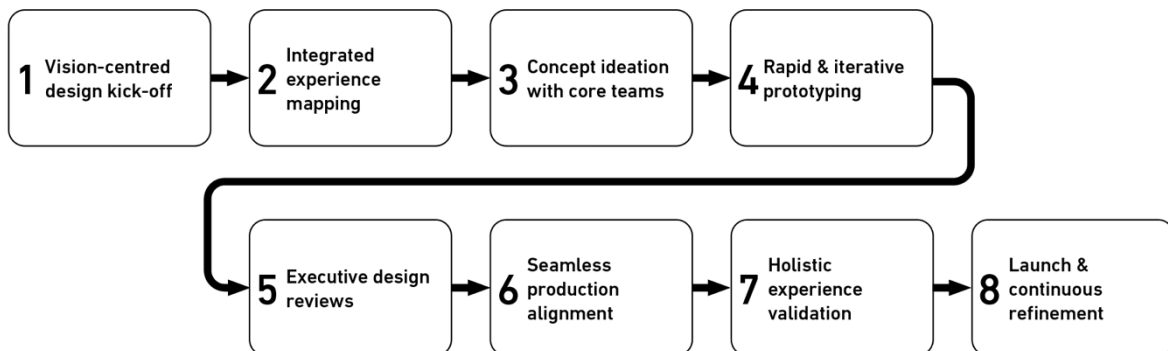


Figure 6. 11: CDP for OBM Firms at Stage 4 of the DDL (Design as Strategy)

CDP for OBM Firms at Stage 4 of the Danish Design Ladder (Figure 6.11)

- Step 1. Vision-centred design kick-off
- Step 2. Integrated experience mapping
- Step 3. Concept ideation with core teams
- Step 4. Rapid & iterative prototyping
- Step 5. Executive design reviews
- Step 6. Seamless production alignment
- Step 7. Holistic experience validation
- Step 8. Launch & continuous refinement

The Stage 4 CDP consists of eight interdependent steps that embed design within strategic decision-making, operational systems, and experience development across the NPD lifecycle.

The first step, vision-centred design kick-off, positions design as the initiator of a unified corporate and product vision. Through foresight and speculative prototyping, design anticipates

future market and cultural shifts, supporting alignment across departments under a shared strategic direction.

The second step, integrated experience mapping, connects user journeys, engineering systems, and brand strategy. By visualising the entire experience ecosystem, firms ensure coherence between tangible and intangible elements of design, enabling consistent value delivery across products and services.

The third and fourth steps, core team ideation and rapid iterative prototyping, institutionalise cross-functional collaboration and continuous validation. Design leads multidisciplinary teams in concurrent problem framing, where prototypes are tested not only for technical feasibility but for emotional and experiential quality. Iteration becomes a central learning mechanism rather than a corrective task.

The fifth step, executive design reviews, integrates design into executive-level decision-making structures. Design quality, brand coherence, and innovation performance are evaluated alongside financial and engineering metrics, ensuring organisational accountability for design outcomes.

The sixth and seventh steps, seamless production alignment and holistic experience validation, ensure that design intent is carried through to manufacturing and user experience. CMF standards and design documentation are integrated into production systems, while real-world usability and brand authenticity are validated through pilot testing and service simulations.

The final step, launch and continuous refinement, transforms design into a continuous organisational learning system. Post-launch analytics and user feedback are codified into a living design playbook, enabling iterative improvement and organisational knowledge transfer.

Theoretically, this process embodies Mozota's (2003) concept of design as a strategic integrator, where design influences organisational direction, management systems, and corporate identity. Practically, it provides a pathway for OBM firms to evolve from reactive manufacturing to proactive innovation leadership, embedding design as a measure of strategic performance and organisational alignment.

Although none of the studied firms currently operate at this level, the Stage 4 CDP outlines a clear trajectory toward design-led transformation. Achieving this maturity requires not only methodological sophistication but also a cultural and leadership shift, where design functions as the cognitive and connective infrastructure that aligns technological excellence, human experience, and strategic intent into a unified framework for sustainable innovation.

Figure 6.12 presents a summarised description of the CDP stages observed in Stage 4 OBM firms, outlining the corresponding design activities and the anticipated outcomes at each phase.

Step	Description	Design Activities	Expected Outcomes
STEP 1 Vision-centred design kick-off	Establish a unified vision integrating business goals, technology direction, and user aspirations	• Conduct executive foresight workshops • Define long-term design vision and experience principles • Align stakeholders on strategic objectives	Create a shared organisational vision that connects design, technology, and strategy while identifying early innovation opportunities
STEP 2 Integrated experience mapping	Connect user journeys, brand touchpoints, and engineering systems into a unified experience framework	• Create experience blueprints and ecosystem maps • Conduct touchpoint audits • Define system-level user experience flows	Align design, engineering, and marketing for coherent experiences and clear value interactions
STEP 3 Concept ideation with core teams	Facilitate cross-department co-creation to turn strategic insights into actionable product concepts	• Run interdisciplinary ideation sessions • Apply design thinking and scenario planning • Develop concept directions integrating multiple perspectives	Achieve balanced concept development across desirability, feasibility, and viability while accelerating collaboration and innovation
STEP 4 Rapid and iterative prototyping	Institutionalise iterative design–test–refine cycles to validate user experience and technical feasibility	• Develop rapid prototypes of varying fidelity • Conduct user testing, A/B trials, and continuous iteration loops	Reduce design risk, validate user experience early, and enable agile response to market and user feedback
STEP 5 Executive design reviews	Embed design into the corporate system through structured evaluation checkpoints	• Hold formal review meetings • Assess design KPIs and brand alignment • Ensure strategic oversight in design decisions	Strengthen executive accountability, integrate design metrics into business evaluation, and elevate design credibility within leadership
STEP 6 Seamless production alignment	Ensure design fidelity and intent across manufacturing and supply chain processes	• Codify CMF and design specifications • Integrate design QA within production systems • Collaborate with suppliers and production engineers	Maintain consistency between design concept and mass production while improving communication and reducing deviations
STEP 7 Holistic experience validation	Evaluate total user experience and emotional impact across physical and digital contexts before launch	• Conduct real-world pilot tests, usability trials, and service simulations • Assess aesthetic and sensory coherence	Verify design integrity and usability, ensure consistent experiences across touchpoints, and strengthen brand authenticity and emotional connection
STEP 8 Launch and continuous refinement	Institutionalise design as a continuous learning process by embedding post-launch insights into future projects	• Collect and analyse post-launch user data • Document design decisions and outcomes • Update internal design playbooks and CMF libraries	Build sustained innovation capability, strengthen organisational learning, and enhance design-led agility for future development

Figure 6. 12: CDP for Stage 4 OBMs

6.6 Assessment of the CDP

The assessment of the CDP in this study aimed to evaluate its comprehensibility, usability, usefulness, and contextual appropriateness. Rather than depending on quantitative metrics or technical indicators, the assessment focused on how OBM practitioners and design experts understood, applied, and interpreted the proposed process within their real organisational settings.

This assessment was grounded in an interpretivist epistemological stance, viewing the design process not as a fixed or prescriptive model but as a socially constructed practice that evolves within organisational contexts. Accordingly, it prioritised pragmatic validity and contextual fit as the primary evaluative criteria.

A total of four experts participated in the assessment, two OBM practitioners and two design consultants, each with more than ten years of professional experience. The assessment was conducted through closed qualitative interviews, lasting approximately sixty minutes each, in a face-to-face format.

This method ensured both consistency and interpretive depth, maintaining a standardised question structure while allowing participants to provide reflective and experiential insights. It is particularly suitable for interpretive qualitative research involving small, expert groups (Kvale, 1996; Patton, 2015). The structured format minimised variability while preserving authenticity, enabling comparative analysis across participants and ensuring analytical rigour in examining complex organisational processes such as design integration.

Through this assessment, the study verified the practical validity and organisational feasibility of the proposed design process. The consistent feedback confirmed that the CDP represents a structurally coherent and operationally applicable framework within industrial practice. These findings provide an empirical foundation for process refinement, reinforcing the CDP's credibility and applicability for design-intensive organisations aiming to institutionalise design as a core capability.

6.6.1 Assessment plan

The evaluation plan of this study was designed to examine the applicability and validity of the proposed CDP through a qualitative assessment conducted with two OBM firms previously involved in the case studies and two design experts.

6.6.2 Feedback from OBM firms

6.6.2.1 *OBM A*

The proposed CDP was identified as a conceptually coherent and practically applicable framework capable of redressing the long-standing imbalance between OBM A's engineering-dominant development structure and its emerging strategic design orientation. The structural clarity and visual transparency of the process effectively demonstrate how design operates as a strategic co-driver rather than a supplementary activity within an R&D-led organisation.

However, the analysis also revealed that successful implementation requires organisational and cultural transformation. OBM A's current NPD system remains sequential and primarily driven by engineering, with design typically engaged only in the later stages. To enable the concurrent and iterative workflow proposed in the CDP, institutional mechanisms such as a dedicated process management unit or a formal design coordination role are needed to ensure cross-functional integration and governance.

Furthermore, the study suggested that design validation should be embedded within existing engineering QA procedures (EVT, DVT, PVT) rather than operated as an independent stream. This integration would enable design and engineering to perform parallel verification within a unified quality framework, enhancing procedural efficiency while maintaining design accountability.

The CDP's inclusion of reflective learning and feedback mechanisms was recognised as essential for developing an organisational design learning system and internalising design capability. Yet, given OBM A's lack of a formal infrastructure for knowledge management, the reflection stage should be linked to existing post-project review and reporting systems, allowing design learning to become a structured and repeatable process.

Overall, the CDP provides OBM A with a practical pathway for advancement from Stage 2 (“Design as styling”) to Stage 3 (“Design as process”) on the Design Ladder. This transition requires more than procedural adoption, it demands decentralised decision-making, cross-departmental reconfiguration, and the institutionalisation of design management functions.

The CDP offers OBM A a unified and scalable framework for embedding design within its NPD operations, transforming fragmented, post-hoc design involvement into an integrated, collaborative, and strategically aligned system that strengthens organisational design maturity and supports sustainable innovation.

6.6.2.2 OBM I

The proposed CDP was recognised as a practical and strategically relevant framework capable of helping OBM I overcome its entrenched engineering-dominant culture and gradually achieve internalisation of design capability. The process was viewed not simply as a procedural enhancement but as a roadmap for transitioning from a technology-oriented organisation to a design-integrated innovation system.

The CDP’s four-stage maturity structure (Stages 1–4) was particularly valued for its sequential applicability, allowing the company to advance design maturity progressively. OBM I’s current NPD system remains linear and verification-led, with design involvement largely limited to post-DVT stages, focusing mainly on form and surface refinement. In contrast, the proposed concurrent and iterative workflow enables design participation from the requirement definition stage, integrating engineering and design validation (EVT–DVT–PVT) into a unified and parallel quality assurance framework, considered both realistic and effective for transitioning from engineering-led to design-led practice.

The CDP was also evaluated as a learning and cultural transformation mechanism. Given OBM I’s prevailing technology-driven mindset, the iterative structure of the process was identified as a means to internalise design thinking through experiential learning, shifting innovation logic from efficiency-centred engineering toward user-oriented design integration.

To strengthen practical implementation, the analysis emphasised the need for clear task ownership and accountability between design and engineering teams at each stage. Explicitly

defining responsibilities, for example, design focusing on user-centred ideation and engineering on structural validation, would reduce ambiguity and enhance cross-functional efficiency. Furthermore, the establishment of a dedicated process coordinator was recommended to manage decision-making alignment and interdepartmental coordination.

The CDP provides OBM I with a structured and progressive framework for embedding design into its organisational system. By clarifying task definitions, formalising coordination mechanisms, and applying the four stages sequentially, OBM I can realistically evolve from an R&D-driven enterprise to a design-integrated innovation organisation, achieving a sustainable balance between technological excellence and design-led strategy.

6.6.3 Feedback from design experts

6.6.3.1 Design expert 1

The CDP was assessed as a methodologically advanced and practically adaptable framework, effectively addressing variations in organisational design maturity through its stage-based structure (Stages 1–4). By differentiating design application according to maturity level, the process prevents the abstraction and misalignment often seen in standardised processes, offering a scalable and context-responsive roadmap for firms at different developmental stages.

The framework's structured flexibility enables organisations with limited design capability to begin with foundational processes (Stages 1–2) and progressively advance toward strategic and integrative management (Stages 3–4). This progression functions as a form of capability scaffolding, allowing design competence to be internalised incrementally while maintaining alignment with existing workflows.

Addressing the persistent design–engineering capability gap, the CDP is positioned not only as a procedural system but as an organisational learning mechanism for standardising collaboration and communication across departments. Clear task ownership and role definition, particularly in Stages 2 and 3, should be formalised and reinforced through training and internal workshops, ensuring consistent interpretation and implementation of the process.

The design process is further conceptualised as a representation of organisational cognition and collaboration, rather than a fixed task sequence. Embedding this perspective within managerial practice enables design to function as an integral part of the firm's decision-making philosophy and a direct contributor to value creation.

When implemented as a cyclical developmental system integrating education, application, and reflection, the CDP operates as a cultural mechanism for embedding design into the organisational mindset. Continuous engagement with the four-stage process supports the transition from procedural adoption to internalised design leadership, positioning design as the core operational language of the organisation.

Overall, the CDP demonstrates three principal strengths:

- 1) Stage-based adaptability that accommodates differing levels of design maturity,
- 2) A learning framework that bridges cross-departmental capability gaps, and
- 3) Cultural alignment that connects organisational mindset with process logic.

These features establish the CDP as a strategically grounded and culturally attuned pathway for transforming design from a peripheral activity into a central driver of innovation and organisational integration.

6.6.3.2 Design expert 2

The CDP was assessed as a well-structured and adaptable framework that achieves a balance between rigour and flexibility, satisfying the essential conditions of an effective process system: usability, manageability, adaptability, and visual clarity. The process' four-level structure (Stages 1–4) provides a scalable pathway that can be selectively applied according to a firm's design maturity and operational environment, allowing for realistic and context-specific adoption.

The differentiation of processes by design maturity level was highlighted as a key strength. This staged approach prevents inefficiency common in standardised design processes and enables organisations to diagnose their current maturity, apply the appropriate process level, and progress systematically toward higher design capability. The inclusion of a design maturity

assessment chart was proposed to further enhance practical usability and help firms define their developmental trajectory.

The CDP also contributes to organisational systematisation by formalising workflows, thereby supporting task consistency and operational efficiency. Early design intervention in NPD was emphasised as a critical factor influencing product quality and market competitiveness. By integrating design at the strategic planning and definition stages, the process strengthens design's direct contribution to innovation and brand value.

For effective implementation, the establishment of a dedicated design process facilitation team was recommended. This team should function not as an executive unit but as a neutral facilitator, guiding engineering, marketing, and R&D departments in process application and fostering a shared operational language across internal and external teams. Such facilitation would enhance collaboration coherence and accelerate adoption throughout the organisation.

The four CDPs were also recognised as potential organisational standards that could serve as central platforms for communication, coordination, and decision alignment. When supported by clear documentation and visual tools, the process can unify cross-departmental communication, reduce ambiguity, and promote a design-oriented culture across the company.

The CDP demonstrates high usability, manageability, flexibility, and clarity, offering a realistic and scalable framework for firms with differing levels of design maturity. By combining structural discipline with adaptive application, the CDP functions as both a capability-building mechanism and a cultural transformation tool, supporting OBM firms in embedding design as a core organisational system and progressing toward design-led innovation.

6.6.4 Discussion

The evaluation results from OBM practitioners and design experts collectively demonstrate that the proposed CDP functions as both a structured developmental pathway and a cultural mechanism for embedding design within manufacturing-oriented organisations. Although the participants' perspectives differed according to their professional domains, engineering-focused OBM practitioners versus design-focused consultants, their feedback converged on a

shared recognition that the process provides a pragmatic and strategically relevant approach to design internalisation.

Both groups consistently highlighted that the CDP effectively translates the abstract concept of “design maturity” into a tangible, actionable, and scalable framework. The four-level stage-based process was regarded as a realistic and adaptive structure that accommodates organisational variations in design capability and maturity. This modular configuration allows firms to begin with fundamental, task-oriented design processes (Stages 1–2) and progressively advance toward higher levels of strategic integration (Stages 3–4). Accordingly, the process serves not only as a process enhancement tool but also as a roadmap for shifting design from a supportive function to a central driver of organisational innovation and strategy.

For OBM A, the process was recognised as a mechanism capable of addressing the long-standing imbalance between engineering-driven development and emerging strategic design functions. The participant praised its structural clarity and visual transparency but stressed that successful implementation requires both organisational and cultural alignment, particularly through the establishment of a process management unit or formalised design coordination role. Integrating design validation into existing verification systems (EVT, DVT, PVT) was also proposed to facilitate concurrent operation of design and engineering within a unified workflow.

By contrast, OBM I viewed the CDP as a practical roadmap for cultural transformation. The participant regarded the four-stage structure as sequentially applicable according to the company’s design maturity level, offering a pathway for gradual design integration without internal resistance. However, he emphasised the need to clarify task ownership between design and engineering departments to ensure accountability and operational precision. Defining distinct but complementary responsibilities would allow the process to operate as a unified NPD–Design system, fostering both cross-departmental coherence and organisational learning.

From the design experts’ perspective, the process demonstrated both methodological robustness and practical flexibility. The first design expert highlighted its potential as an organisational learning mechanism capable of addressing capability gaps between design and engineering teams through defined workflows and structured training. The second design expert emphasised its systemic applicability, proposing that the process could serve as an organisational communication platform and recommending the formation of a dedicated

process facilitation team to guide implementation and foster process consistency across departments and with external design agencies.

The convergent and divergent findings from the evaluation interviews are summarised in Table 6.4, which presents a comparative overview of feedback from OBM practitioners and design experts regarding the applicability, strengths, and contextual challenges of the proposed CDP.

Table 6. 4: Comparative summary of evaluation feedback from OBM firms and design experts

Category	Key evaluation focus	Key Insights / Strengths Identified	Implementation Implications / Recommendations
OBM A	Application within an engineering-led organisation	• The process provides structural clarity and visual transparency • Useful for explaining the strategic role of design in a technology-centric environment • Conceptually coherent and practically applicable	• Requires organisational and cultural alignment for effective adoption • Establish a process management unit or formal design coordinator role • Integrate design validation with existing QA procedures (EVT, DVT, PVT) for concurrent design–engineering operations
OBM I	Design internalisation and capability building	• Recognises the process as a cultural transformation roadmap • Four-stage process allows sequential, maturity-based adoption • Encourages integration of design within NPD without resistance	• Clarify task ownership between design and engineering • Define explicit departmental responsibilities • Apply processes sequentially to build design maturity toward Stage 4 – Design as Strategy
Design Expert 1	Organisational learning and collaboration mechanisms	• Four-stage structure provides scalable design maturity progression • Addresses capability gaps between design and engineering • Supports training, reflective learning, and performance equalisation	• Embed workflows and task definitions in training sessions • Use the process as a framework for organisational learning and process standardisation • Encourage managerial understanding of design as an operational philosophy

Design Expert 2	Systemisation, facilitation, and communication structure	• Satisfies four core criteria: usability, manageability, flexibility, and visual clarity • Can evolve into an organisational communication platform • Enhances early design intervention in NPD	• Form a dedicated design process facilitation team to coordinate departments and external agencies • Institutionalise the four Collaborative Processes as organisational standards • Use process documentation and visualisation tools to embed design-oriented thinking

Across all evaluation interviews, several convergent insights emerged that highlight the conceptual robustness and practical relevance of the CDP.

First, both OBM practitioners and design experts agreed that the process bridges the long-standing divide between engineering-led efficiency and design-led creativity, providing a structured yet flexible framework for integration. The stage-based maturity system (Stages 1–4) was consistently identified as one of its greatest strengths, offering scalability and contextual adaptability according to each organisation’s design capability and readiness.

Second, the process was recognised as a learning and capability-building mechanism that fosters reflective learning, knowledge transfer, and capability equalisation between departments, particularly between design and engineering. This dimension is especially significant for OBM firms where disparities in design literacy often hinder collaboration and innovation.

Third, participants from both groups stressed the importance of clear task ownership, process facilitation, and communication structure. They agreed that success depends on how responsibilities are defined, coordinated, and institutionalised. The establishment of a dedicated process facilitation team or formal design coordinator role was therefore seen as essential for ensuring process adoption and cross-functional integration.

Finally, the evaluation confirmed that the CDP operates not only as an operational framework but also as a cultural mechanism for the long-term internalisation of design within OBM firms. By combining structured process logic with iterative feedback loops and visual clarity, the process enables design to evolve from a peripheral support activity to a core strategic capability. As such, it contributes simultaneously to organisational learning and sustainable innovation,

providing a pathway for OBM firms to advance progressively toward Stage 4 – Design as Strategy.

The evaluation confirms that the CDP provides a theoretically coherent and operationally feasible framework for bridging the divide between engineering efficiency and design creativity. Through the combination of stage-based maturity progression and structurally defined process, the framework offers a scalable pathway for design internalisation, empowering OBM firms to evolve from functional efficiency toward sustainable, design-led strategy.

6.7 The final CDP

6.7.1 The final CDP for Stage 1 OBMs

The final CDP for Stage 1 OBM firms establishes the institutional foundation for systematically integrating external design agencies into the organisation's product development and production systems. At this initial stage, design transitions from a supportive function to a capability co-leading role, collaborating with the PMO, engineering, manufacturing, and quality departments from the earliest project stages. The primary goal of the Stage 1 CDP is not to introduce an entirely new management system but to internalise design within existing organisational processes as a formalised and repeatable procedure, thereby enabling the firm to develop familiarity with design-led collaboration.

The revised Stage 1 CDP strengthens three structural dimensions compared to its earlier process: integration, accountability, and learning continuity.

First, external design agencies, the PMO, engineering, and manufacturing teams collaborate from the outset, allowing creative decision-making and technical evaluation to progress in parallel.

Second, the R&R framework clearly defines each department's area of responsibility and scope of decision-making. Design-related decisions are jointly undertaken by the external design agency and the PMO, while engineering and manufacturing serve as the principal executors of

technical validation and on-site implementation. This configuration prevents overlapping responsibilities, enhances transparency, and ensures a balanced decision-making structure.

Third, the appointment of a process manager within the PMO ensures the continuity of documentation, review, and knowledge accumulation, enabling each project's outcome to be converted into an organisational learning asset.

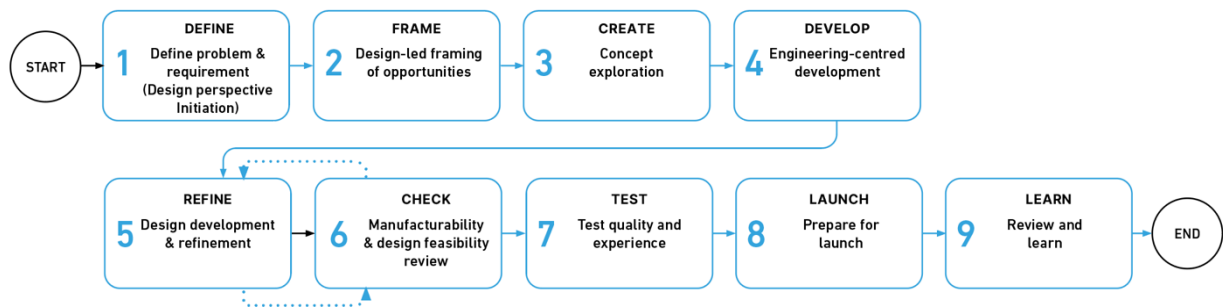


Figure 6. 13: The final CDP for OBM Firms at Stage 1 of the DDL (No Design)

The final CDP for OBM Firms at Stage 1 of the Danish Design Ladder (Figure 6.13)

- Step 1. Problem & requirements clarification
- Step 2. Design-led product framing
- Step 3. Low-fidelity concept exploration & check
- Step 4. Engineering-centred solution development
- Step 5. Design development & visual refinement
- Step 6. Manufacturability & design feasibility review
- Step 7. Compliance & experience-aware QA
- Step 8. Launch preparation & communication support
- Step 9. Post-launch review & design learning

The final CDP developed for OBM firms positioned at Stage 1 of the Danish Design Ladder comprises nine sequential yet interconnected steps: problem and requirement definition → design-led product framing → concept exploration → engineering-centred development → design refinement → manufacturability review → quality and experience testing → launch preparation → post-launch learning and feedback.

Each phase is linked through iterative feedback loops, most notably the Refine–Check (design–engineering iteration loop), which enables real-time resolution of design and production challenges rather than retrospective correction. This ensures that learning occurs continuously throughout development, enhancing both process efficiency and cross-functional understanding.

In parallel, the integration of the EVT–DVT–PVT (Engineering Validation Test–Design Validation Test–Production Validation Test) system embeds design verification within technical validation and quality management. This alignment ensures that experiential quality and engineering feasibility are evaluated simultaneously, maintaining consistent standards across all development stages. The convergence of design and engineering validation deepens mutual understanding and reinforces the shared accountability of both disciplines.

The key strength of Stage 1 lies in the institutionalisation of design as a repeatable, accountable, and collaboration-oriented process within the organisation. The R&R framework clearly delineates task ownership and decision traceability, while the PMO-led documentation and review system supports cumulative learning and knowledge transfer. As a result, collaboration between external design consultancies and internal departments becomes progressively embedded within the organisational culture, transforming design from a peripheral activity into a formalised operational function.

Stage 1 therefore marks the transition from previously fragmented, functionally isolated workflows to a structured and cooperative development system. By embedding accountability, feedback, and learning cycles, design becomes an integral part of formal product development rather than an aesthetic afterthought. This institutional foundation enables OBM firms with low design maturity to progress toward Stage 2, where design evolves into a user-centred and innovation-oriented organisational practice.

Accordingly, Figure 6.14 summarises the final CDP structure applied in Stage 1 OBM firms, outlining the corresponding design activities and anticipated outcomes at each phase.

Step	Description	Design Activities	Expected Outcomes
STEP 1 Problem & requirements clarification	Define project goals and technical constraints while integrating design from the start	- Hold PMO kickoff meeting - Map stakeholders - Set success criteria and constraints	Deliver project brief v1, stakeholder map, and requirement summary for clear alignment and reduced change risks
STEP 2 Design-led product framing	Establish user-centred value propositions and experiential goals	- Derive UX insights and value propositions - Conduct framing workshop - Draft UX intent statement	Deliver value proposition canvas and UX intent statement to position design as a problem-definition tool and embed user value
STEP 3 Low-fidelity concept exploration & check	Identify risks from user and technical perspectives	- Develop sketches and mock-ups - Conduct concept risk assessment - Perform preliminary usability testing	Deliver concept sketches, risk register, and concept shortlist for early design-engineering review and reduced rework
STEP 4 Engineering-centred solution development	Strengthen design-engineering collaboration for alignment	- Conduct CAD design reviews - Hold design checkpoints - Evaluate form-function alignment	Deliver system diagram, initial BoM, and alignment log to ensure design-engineering consistency and document coordination history
STEP 5 Design development & visual refinement	Integrate visual quality with technical specifications	- Prepare CMF board - Create interface mock-ups - Conduct EVT-linked review	Deliver CMF board, interface mock-ups, and surface data for concurrent form-function review and reduced late-stage revisions
STEP 6 Manufacturability & design feasibility review	Assess production feasibility using DFM/DFA principles	- Conduct joint design-engineering review - Evaluate tolerance and machining limits - Document mitigation measures	Deliver DFM/DFA review record, tolerance log, and risk mitigation report to validate manufacturability, remove redundancy, and enhance efficiency
STEP 7 Compliance & experience-aware QA	Review regulatory compliance and UX quality in parallel	- Integrate QA and UX checklists - Conduct brand consistency review - Operate unified validation pack	Deliver QA-Design Validation Pack and UX checklist to merge QA and design validation and detect usability issues early
STEP 8 Launch preparation & communication support	Ensure coherent launch readiness across manufacturing, marketing, and service	- Develop launch narrative - Produce visual and manual materials - Conduct PVT readiness review	Deliver launch package and communication storyboard to maintain brand coherence and prevent launch confusion
STEP 9 Post-launch review & design learning	Systematise post-project learning and knowledge accumulation	- Hold post-review workshop - Analyse user feedback - Update knowledge repository	Deliver project review report and repository records to embed learning, enhance design capability, and support continuous improvement

Figure 6. 14: Summary of the final CDP for OBM Firms at Stage 1

6.7.1.1. Practical Application for Stage 1

At Stage 1 OBM, the CDP is introduced as a practical and accessible framework that firms can adopt through small-scale, short-term pilot projects, typically spanning three to four months and involving relatively low levels of complexity, rather than organisation-wide implementation. Given the limited level of design maturity at this stage, companies are not expected to fully institutionalise design across all organisational functions. Instead, the CDP is selectively applied to these pilot projects, enabling both the OBM firm and the external design agency to establish a shared working rhythm and collaborative foundation. Through this initial application, the organisation begins to recognise how design contributes beyond aesthetics, particularly in early problem framing, concept validation, and cross-functional coordination. In this respect, the CDP at Stage 1 functions as a low-risk entry point, allowing firms to experiment with structured collaboration in a controlled environment without requiring significant organisational restructuring.

As these pilot projects progress, emphasis is placed on developing familiarity, clarifying roles, and establishing iterative communication between the external design agency and internal teams. The process supports the gradual development of independent coordination capabilities within the organisation, particularly through the involvement of the PMO and the introduction of basic R&R structures. Over time, repeated exposure to this structured collaboration enables the firm to transition from ad hoc and fragmented workflows toward a more stable and predictable working model. The primary objective at this stage is therefore not optimisation but transition, allowing the organisation to build confidence in collaborative design practices and establishing a foundation for progression toward higher levels of design integration, where design becomes a strategically embedded capability.

6.7.2 The final CDP for Stage 2 OBMs

The final CDP for Stage 2 OBM firms builds upon the institutional foundation established in Stage 1, evolving from a guided collaboration process into an integrated and iterative co-exploration system. At this stage, the external design agency functions as a strategic co-partner with the PMO and engineering departments, transforming design from a supportive function into a data-driven and verifiable capability. This phase is particularly suited to firms

that have begun to recognise the strategic value of design and seek to internalise it as a user-centred and sustainable innovation system.

The Stage 2 CDP is structured around three fundamental pillars; user-centred discovery, cross-functional ideation, and iterative testing that together establish a cohesive and learning-oriented collaboration framework. Rather than functioning merely as a procedural process for product development, the Stage 2 CDP operates as an organisational learning system that integrates design, engineering, manufacturing, marketing, and quality into a unified decision-making structure. Through this process, design becomes recognised as a repeatable and measurable operational capability, enhancing alignment between technical feasibility and user experience across departments.

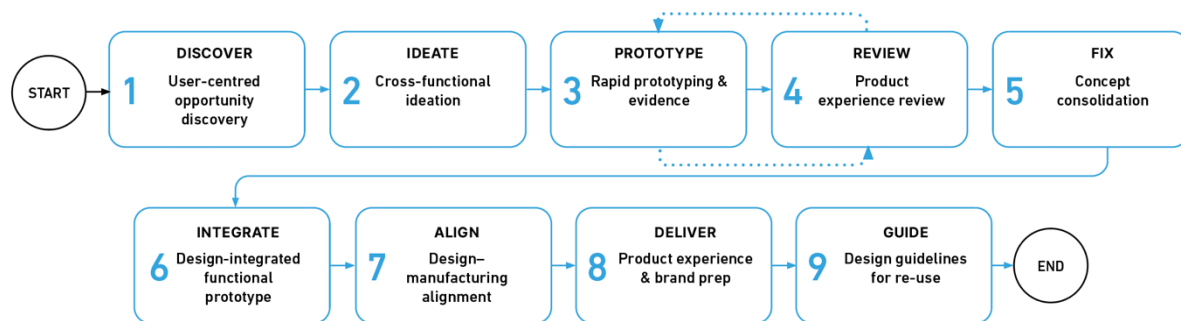


Figure 6. 15: The final CDP for OBM Firms at Stage 2 of the DDL (Design as Styling)

The final CDP for OBM Firms at Stage 2 of the Danish Design Ladder (Figure 6.15)

- Step 1. User-centred opportunity discovery
- Step 2. Cross-functional ideation
- Step 3. Rapid prototyping
- Step 4. Product experience review
- Step 5. Concept consolidation
- Step 6. Design-integrated functional prototype
- Step 7. Design–manufacturing alignment
- Step 8. Product experience & brand preparation
- Step 9. Design guidelines for re-use

The final CDP for Stage 2 OBM firms comprises nine interconnected stages: user-centred opportunity discovery → cross-functional ideation → rapid prototyping and experience review → concept consolidation → design-integrated functional prototyping → design–manufacturing alignment → product experience and brand readiness → creation of reusable design guidelines. Each stage embeds user insight, technical feasibility, and experiential quality within a unified decision framework.

A defining advancement at this stage lies in the structural transition from technology-oriented development to user-centred development. Through behavioural observation, user research, and data-driven analysis, design functions as an empirical foundation that informs both strategic and technical decision-making, moving beyond intuition-led or technology-first approaches towards a more systematic and evidence-based development paradigm. In particular, the iterative loop composed of rapid prototyping and product experience review in Steps 3 and 4 replaces the Refine–Check structure of Stage 1 and operates as a core process structure that enables real-time alignment between functional and experiential requirements. This transition ensures that user perspectives are systematically embedded from the early stages of development, thereby reconfiguring the underlying development logic from a technology-first approach to a more balanced and integrated evaluation framework that considers both performance and experience. Consequently, this iterative process structure extends beyond procedural refinement by reinforcing cross-functional interaction and facilitating continuous knowledge exchange and organisational learning throughout the development process, ultimately contributing to the progressive advancement of design integration within the organisation.

Collaboration in Stage 2 is governed by a refined R&R framework that defines task ownership and process transparency. External design agencies lead the early phases of user research and concept definition, while the Project Management Office (PMO) coordinates process documentation and decision alignment. Engineering, manufacturing, and marketing departments retain domain-specific authority, ensuring technical reliability and operational efficiency. This balanced distribution of responsibility not only clarifies accountability boundaries but also converts cross-functional collaboration into a traceable and repeatable organisational capability.

Design verification is systematically integrated into production and quality management systems. The EVT–DVT–PVT (Engineering, Design, and Production Validation Test) framework operates as a parallel validation mechanism, maintaining consistency in quality and performance from prototyping to mass production. This convergence reinforces shared understanding between design and engineering, ensuring alignment between experiential intent and technical execution across all development phases.

Stage 2 thus marks a pivotal transition in which design evolves from a supportive function into a strategic integrative structure connecting user insight, technological competence, and production capability. Iterative experimentation, structured feedback, and cumulative documentation become embedded within organisational routines, positioning design as both a mechanism of learning and a managed operational capability. In this way, Stage 2 represents not merely the consolidation of collaboration but a decisive turning point where design matures into a sustainable innovation system. This evolution establishes the conceptual and procedural foundation for Stage 3, where design emerges as the organisation’s central cognitive and strategic framework.

Figure 6.16 summarises the final CDP structure observed in Stage 2 OBM firms, outlining the key design activities and anticipated outcomes associated with each phase.

Step	Description	Design Activities	Expected Outcomes
STEP 1 User-centred opportunity discovery	Transition from technology-driven to user-driven mindset	- Conduct user research (JTBD, journey mapping) - Identify latent needs and contextual constraints - Develop opportunity matrices	Deliver user journey maps and opportunity matrix for evidence-based problem framing and clear strategic direction
STEP 2 Cross-functional ideation	Establish integrative ideation among design, engineering, and marketing	- Facilitate cross-department workshops - Create concept sketches and visual boards - Develop ideas connecting functional and emotional value	Deliver co-ideation boards and concept sketches to build a shared design language and strengthen creative problem-solving
STEP 3 Rapid prototyping	Validate design hypotheses through rapid experimentation	- Build low-fidelity prototypes - Conduct usability testing and gather feedback - Identify key improvement points	Deliver prototypes and feedback logs for early risk detection and iterative learning
STEP 4 Product experience review	Evaluate product experience from the user's perspective	- Assess usability, emotional appeal, and brand coherence - Hold adjustment sessions - Finalise UX improvement proposals	Deliver experience evaluation report and UX feedback summary to strengthen experience quality and enhance user satisfaction
STEP 5 Concept consolidation	Reconcile design intentions with technical constraints	- Hold co-review meetings - Document trade-offs - Prepare consolidated concept dossiers	Deliver integrated concept dossier to ensure design-engineering coherence and transparent collaboration
STEP 6 Design-integrated functional prototype	Conduct concurrent verification of functionality and form	- Jointly build integrated prototypes - Record CMF and tolerance compromises - Test in real-use scenarios	Deliver functional prototypes and compromise logs to align design with technical intent and reduce modification costs
STEP 7 Design-manufacturing alignment	Harmonise design intent with production conditions	- Develop pilot build plans - Draft surface and assembly guidelines - Integrate manufacturing feedback	Deliver pilot build plan and assembly guideline to improve production quality and manufacturing efficiency
STEP 8 Product experience & brand preparation	Build consistent alignment between product and brand experience	- Develop training materials and service scripts - Align brand communication elements	Deliver brand experience guide and service scenarios to ensure a consistent customer experience and strengthen brand perception
STEP 9 Design guidelines for re-use	Institutionalise design knowledge as an organisational asset	- Develop design playbooks - Build pattern libraries - Hold internal sharing workshops	Deliver design playbook and pattern library to internalise learning and enhance design efficiency

Figure 6. 16: Summary of the final CDP for OBM Firms at Stage 2

6.7.2.1. Practical Application for Stage 2

The application of the CDP at Stage 2 demonstrates a more structured and transitional mode of adoption compared to Stage 1. Although design maturity remains limited at this stage, firms have already accumulated initial experience with CDPs through short-term pilot projects. Accordingly, the CDP is no longer confined to short-term exploratory initiatives but is progressively introduced into medium- to long-term development projects, typically spanning approximately five to eight months and involving increasing levels of complexity, in which key organisational functions, including engineering, manufacturing, marketing, and the PMO, actively participate. These projects function as structured learning environments in which engineering-driven organisations gradually become familiar with design-related terminology, processes, and collaborative practices.

According to the characteristics of Stage 2 firms, design is formally recognised within the organisation but remains largely confined to styling and post-engineering refinement activities. In response, the CDP aims to expand the role of design beyond mere visual enhancement. By embedding design in the early stages of development and facilitating cross-functional collaboration, the CDP encourages a transition from sequential, technology-driven workflows to more integrated and concurrent collaboration models. In this context, the CDP is not intended to achieve immediate organisation-wide transformation, but rather to support gradual capability building, enabling teams to engage more proactively and confidently in design-led activities compared to Stage 1.

Through repeated application of the CDP in strategically selected projects, organisations begin to internalise a shared design language and develop a more holistic understanding of how design contributes to product definition, user experience, and decision-making. This transformation is further reinforced through managerial alignment and structured learning mechanisms, such as training programmes and cross-functional workshops, which help reduce communicative and cultural barriers between departments. As a result, the CDP at Stage 2 functions not only as an operational process but also as a capability-building framework that expands the practical utilisation of design while preparing the organisation for deeper integration in subsequent stages.

6.7.3 The final CDP for Stage 3 OBM

The final CDP for Stage 3 OBM firms advances the integrated collaboration framework established in Stage 2 into a strategic management system that embeds design directly within the organisation's decision-making architecture. At this stage, design evolves beyond a coordination tool to become a core mechanism for strategic alignment across the enterprise, functioning as a cognitive language that structures organisational thinking and decision-making.

The Stage 3 CDP follows a cyclical structure, Plan → Co-create → Develop → Define → Test → Integrate → Finalise → Deliver, where each stage operates as both an autonomous decision domain and a feedback node. This iterative process ensures sustained strategic coherence, organisational learning, and knowledge accumulation, positioning design as a central driver of corporate intelligence and adaptability.

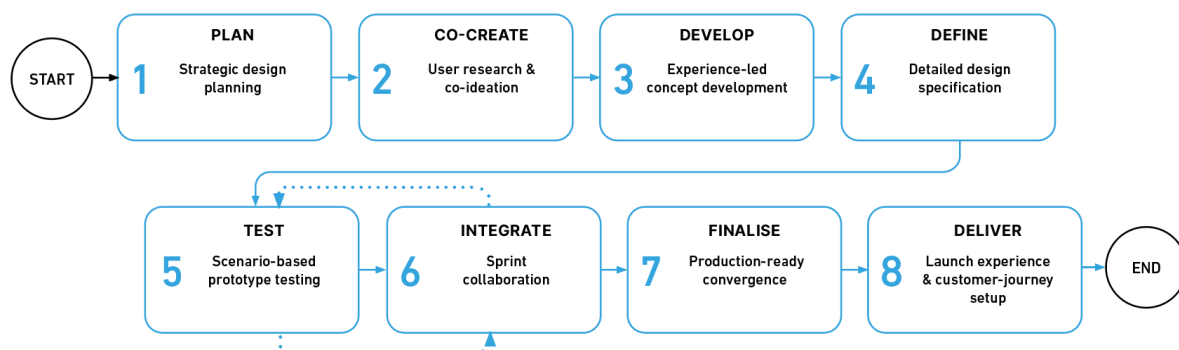


Figure 6. 17: The final CDP for OBM Firms at Stage 3 of the DDL (Design as Process)

The final CDP for OBM Firms at Stage 3 of the Danish Design Ladder (Figure 6.17)

- Step 1. Strategic design planning & product line-up fit
- Step 2. User research & co-ideation workshops
- Step 3. Experience-led concept development
- Step 4. Detailed design specifications
- Step 5. Scenario-based prototype testing
- Step 6. Design–engineering sprint collaboration
- Step 7. Production-ready design & quality convergence
- Step 8. Launch experience & customer-journey setup

In the strategic design planning phase, the external design agency collaborates with the PMO and executive leadership to visualise portfolio alignment, investment priorities, and resource allocation. Through this collaboration, design insight becomes both a qualitative and quantitative foundation for managerial decision-making. During the user research and co-ideation phase, design, engineering, and marketing integrate user insights, technological validation, and market analysis to establish a shared design territory, reinforcing cognitive alignment across functions.

In experience-led concept development, experiential dimensions such as usability, emotion, and accessibility are embedded into early-stage evaluation and investment logic. The design specification and scenario-based prototype testing phase unites functional, experiential, and production validation under shared accountability between design and engineering. At this point, the external design agency contributes selectively, focusing on conceptual validation and emotional coherence, while internal teams lead detailed implementation and documentation of knowledge gained.

The design–engineering sprint collaboration phase institutionalises short, iterative cycles that synchronise technical refinement with experiential enhancement. Engineering assumes executional responsibility, design maintains user experience coherence, and the PMO oversees scheduling and cross-functional alignment. The subsequent design–engineering–brand validation phase integrates functional, aesthetic, and brand evaluations within a unified quality review system, ensuring holistic coherence across departments under PMO coordination.

In the launch experience and customer journey setup phase, the PMO and marketing lead launch operations and customer experience planning, while design contributes to brand narrative formation and interpretation of user feedback. The resulting customer experience playbook and feedback system transform post-launch insights into organisational learning, feeding data and reflection back into the next strategic design planning cycle.

The Stage 3 CDP operates under a structured R&R framework. The PMO holds primary managerial accountability, the external design agency provides strategic direction during conceptual and validation phases, and engineering, manufacturing, and marketing act as operational executors ensuring technical feasibility and production efficiency. This structure

enhances decision consistency, eliminates redundancy, and reinforces cross-functional alignment throughout the process.

Stage 3 marks the institutionalisation of design as an organisational cognitive system, a strategic infrastructure that integrates technology, brand, and user experience within an interconnected management logic. Within this framework, the PMO functions as the coordinator, the design agency as the strategic validator, and engineering as the operational implementer. Through this configuration, OBM firms transform design into a foundation for sustainable innovation and organisational intelligence, establishing the structural and conceptual groundwork for Stage 4, where design evolves into the organisation's strategic operating system itself.

Stage 3 thus signifies the transformation of design into a strategic language that directly interfaces with executive-level decision-making. The QA framework expands into an integrated brand–technology verification system, positioning design as the organisational medium through which strategy, development, and learning converge. The objective of NPD at this stage shifts from continuous refinement to experience readiness, reflecting the firm's transition toward market validation through experience-driven launch preparation and cross-functional alignment of brand and technological coherence.

Figure 6.18 summarises the final CDP structure observed in Stage 3 OBM firms, outlining the key design activities and anticipated outcomes associated with each phase.

Step	Description	Design Activities	Expected Outcomes
STEP 1 Strategic design planning & product line-up fit	Integrate design with corporate strategy and investment decisions	- Hold joint design–strategy workshops - Develop portfolio maps - Formulate opportunity theses based on investment feasibility	Establish managerial legitimacy of design and strengthen alignment across strategy, investment, and design
STEP 2 User research & co-ideation workshops	Generate multidisciplinary ideas based on user insights	- Synthesise market and user research - Facilitate co-ideation sessions - Define design territories	Establish user-oriented design direction and unify frameworks across departments
STEP 3 Experience-led concept development	Establish core product concepts emphasising emotional and usability values	- Develop CX storyboards - Formulate concept statements - Integrate brand and emotional elements	Embed experiential quality early and minimise late-stage revisions
STEP 4 Detailed design specifications	Enable all teams to collaborate using a unified reference document	- Merge UX and technical specifications - Finalise CMF and tolerance parameters - Manage integrated specification packs	Centralise design documentation and reduce communication and coordination costs
STEP 5 Scenario-based prototype testing	Validate experiential and technical performance in real-world conditions	- Conduct field and bench testing - Analyse experience metrics and usability data - Implement iterative improvement loops	Verify design through quantitative and qualitative evidence to enhance user suitability
STEP 6 Design–engineering sprint	Establish joint decision-making between design and engineering	- Define sprint goals and backlogs - Hold regular reviews and feedback sessions - Align sprints with experiential KPIs	Shorten iteration cycles and strengthen mutual accountability between teams
STEP 7 Production-ready design & quality convergence	Achieve full integration between design intent and quality standards	- Join pilot builds - Conduct product sample and brand-fit audits - Align QA standards with design specifications	Eliminate redundant validation and maintain design fidelity during production
STEP 8 Launch experience & customer-journey setup	Manage post-launch user experience through integrated customer journeys	- Develop CX playbooks - Create channel-specific launch toolkits - Design coordinated service and sales scenarios	Reinforce brand consistency and enhance reproducibility of market experience

Figure 6. 18: Summary of the final CDP for OBM Firms at Stage 3

6.7.3.1. Practical Application for Stage 3

At Stage 3, the CDP is no longer applied as a structured collaboration framework but becomes embedded as an integrated process that guides and coordinates the entire project lifecycle. Having internalised the CDP through earlier stages, organisations begin to apply the process

from the initial planning phase, aligning design activities with overall product direction and development strategy. The CDP is actively implemented in medium- to long-term development projects, typically spanning ten to twelve months and involving high levels of cross-functional coordination and organisational complexity, where key organisational functions, including engineering, R&D, marketing, and production, are consistently involved throughout the process.

At this stage, design operates as a core process capability, contributing not only to form and usability but also to problem framing, concept direction, and experience evaluation. Cross-functional collaboration becomes more fluid and coordinated, with engineers increasingly engaging in design-led activities and decision-making. External design agencies are no longer peripheral contributors but deeply embedded partners, participating across multiple stages of the CDP and working closely with internal teams to ensure alignment between user experience, technical feasibility, and production requirements.

While design at Stage 3 remains primarily process-driven rather than fully strategic, the CDP enables organisations to manage development activities in a more coherent, integrated, and controlled manner. Through continuous iteration, structured feedback, and accumulated learning, organisations begin to stabilise process ownership and strengthen internal capabilities. In this sense, Stage 3 represents a critical transition point in which design becomes an operational backbone of development, laying the foundation for its evolution into a fully strategic management system in the next stage.

6.7.4 The final CDP for Stage 4 OBMs

The Stage 4 CDP embodies the culmination of design's institutional evolution, signifying its complete establishment as the cognitive, cultural, and operational core of the organisation. At this level, design transcends coordination to function as an epistemic system of organisational reasoning—a structured process through which strategic intent is shaped, execution is directed, and continuous learning is sustained.

The Stage 4 process consists of a cyclical structure, Envision → Map → Ideate → Prototype → Review → Align → Validate → Evolve. Together, these phases merge planning, execution, and feedback into a single cognitive system of strategic learning.

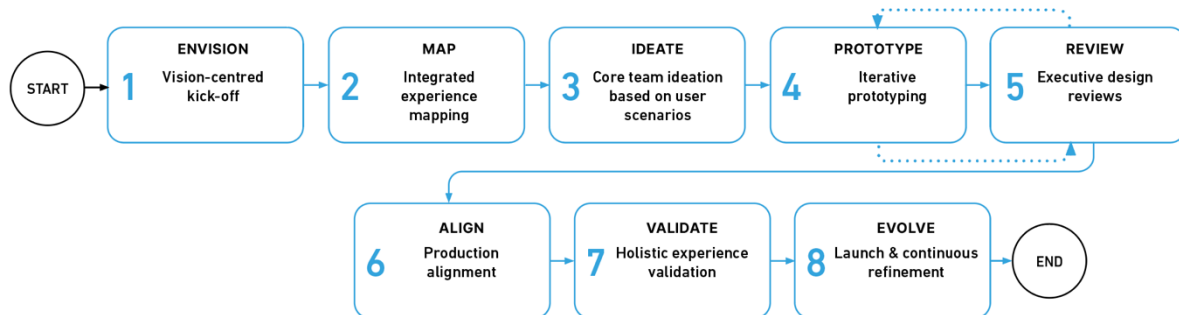


Figure 6. 19: The final CDP for OBM Firms at Stage 4 of the DDL (Design as Strategy)

The final CDP for OBM Firms at Stage 4 of the Danish Design Ladder (Figure 6.19)

- Step 1. Vision-centred kick-off
- Step 2. Integrated experience mapping
- Step 3. Core team ideation based on user scenarios
- Step 4. Iterative prototyping review
- Step 5. Executive design reviews (within the loop)
- Step 6. Production alignment
- Step 7. Holistic experience validation
- Step 8. Launch & continuous refinement

In the vision-centred kick-off and experience-mapping phases, design collaborates with executives and the PMO to align corporate vision, innovation priorities, and experiential architecture, replacing fragmented departmental planning with a unified framework linking strategy, technology, and service. Core-team ideation and iterative prototyping embed experimentation and validation within daily operations, reinforcing agility and data-driven innovation.

Executive design reviews institutionalise design as a measurable management tool, integrating user-experience metrics and brand KPIs into corporate performance evaluation. During production alignment and experience validation, design is fully embedded within

manufacturing and quality systems, ensuring technical precision and emotional coherence. Finally, launch and continuous refinement convert market data and user feedback into organisational learning, reintegrating insights into the next vision cycle to sustain feedback-driven innovation.

The Stage 4 CDP operates under a structured R&R framework: executives act as strategic decision-makers; the PMO functions as both process coordinator and learning manager; engineering and marketing retain operational responsibility; and the external design agency serves as a selective strategic facilitator.

Stage 4 (Figure 6.19) represents the full institutionalisation of design as the organisation's operating system. Vision, execution, and learning converge within a self-reinforcing loop where design functions not as a discrete process but as a cognitive and operational infrastructure that governs the enterprise. Strategy, technology, brand, and experience are managed as an interdependent continuum, with design serving as the organising principle that defines how the firm thinks, acts, and evolves.

Figure 6.20 summarises the final CDP structure observed in Stage 4 OBM firms, outlining the key design activities and anticipated outcomes associated with each phase.

Step	Description	Design Activities	Expected Outcomes
STEP 1 Vision-centred kick-off	Establish the long-term corporate vision and define design's strategic direction	- Executives and PMO collaboratively define the brand vision and innovation goals - Integrate design as a strategic decision-making axis	Position design as the foundation of corporate strategy, ensuring consistent and coherent innovation direction
STEP 2 Integrated experience mapping	Integrate experience strategies across product, service, and digital domains	- Collaborate across departments to develop an integrated ecosystem map - Set experience KPIs - Ensure alignment across all touchpoints	Achieve coherence among technology, service, and brand while establishing an experience-centred organisational structure
STEP 3 Core team ideation based on user scenarios	Establish a multi-departmental collaboration structure centred on user scenarios	- Simulate real usage contexts - Facilitate collaboration among design, engineering, and marketing teams - Balance technical constraints with user value	Balance feasibility and innovation while promoting strategic cross-functional collaboration
STEP 4 Iterative prototyping review	Enhance design quality through a continuous design-validation-learning loop	- Develop multi-layered prototypes - Conduct repeated user validation - Perform technical adjustments based on feedback	Embed organisational learning, improve design completeness, and reduce failure risk
STEP 5 Executive design reviews (within the loop)	Institutionalise data-driven design evaluation and executive approval	- Review design KPIs, experience data, and brand coherence - Make evidence-based management decisions	Embed design within executive decision-making and strengthen design leadership at the management level
STEP 6 Production alignment	Reflect design intent in manufacturing and maintain brand consistency	- Integrate CMF guidelines and design specifications into manufacturing and supply chain processes - Synchronise with QA systems to ensure consistency and quality	Ensure physical consistency of design intent and enhance brand reliability
STEP 7 Holistic experience validation	To verify integrated experience quality before and after market entry	- Conduct quantitative evaluation using service data - Conduct qualitative evaluation based on user feedback	Enables real-time improvement of experience quality and ensures emotional and brand consistency
STEP 8 Launch & continuous refinement	To establish a continuous learning loop based on market feedback	- Analyse post-launch user insights and data - Update the design playbook - Operate iterative improvement cycles	Transforms design into an organisational learning asset and supports sustainable innovation

Figure 6. 20: Summary of the final CDP for OBM Firms at Stage 4

6.7.4.1. Practical Application for Stage 4

At Stage 4, the application of the CDP extends beyond project-level implementation to function as an organisation-wide strategic system embedded within leadership, vision, and culture. Rather than being selectively applied to specific development programmes, the CDP is

deployed across the entire portfolio of new product development initiatives, with executive leadership shaping project direction from the outset. At this level, planning, decision-making, and execution are continuously aligned through the CDP, enabling organisations to define project scope, strategic intent, and long-term positioning. The CDP is no longer bound to discrete project timelines but operates as a continuous strategic system, typically extending beyond twelve months and characterised by sustained collaboration with external design agencies as long-term strategic partners.

Design at Stage 4 operates as a strategic integrator connecting technological capability, brand identity, and user experience within a unified innovation framework. Cross-functional collaboration becomes embedded and routine, with engineering, marketing, and production working seamlessly within design-led processes. Engineers actively contribute to design-driven strategy, reflecting a shift from operational participation to strategic engagement.

External design agencies evolve into co-strategic partners, engaging in executive-level discussions and long-term transformation initiatives. Their role extends beyond product development to include vision setting, scenario planning, and market positioning, strengthening the organisation's future-oriented decision-making.

The CDP at Stage 4 functions as a strategic operating system that aligns vision, execution, and learning. Through continuous cycles of reflection and validation, organisations build the capability to respond to uncertainty while maintaining strategic coherence. In this sense, the CDP defines how the organisation thinks, decides, and innovates.

6.8 Chapter summary

This chapter synthesised the theoretical, empirical, and methodological findings of the study to present an integrated understanding of how design processes are conceptualised, implemented, and evolved within OBM firms. Through comparative analysis of international brands, design agencies, and OBM firms, the chapter identified how design maturity develops as both a structural and cultural transformation, progressing from aesthetic styling to process integration, and ultimately to a strategic organisational capability.

The discussion first established that classical design process models, such as those by Archer, Pahl & Beitz, Ulrich & Eppinger, and the Design Council offer procedural rigour but inadequately reflect the iterative, adaptive, and socially embedded nature of industrial design in manufacturing contexts. Empirical findings confirmed that OBM firms operating under engineering-led hierarchies often limit design participation to downstream stages, preventing its contribution to innovation alignment and learning. In contrast, iterative and human-centred frameworks proposed by Jones, Lawson, and Buchanan were found conceptually rich yet operationally challenging for firms with low design literacy or rigid hierarchies. Synthesising both theoretical and field data, the study redefined design as a dynamic organisational learning system, an integrative mechanism that connects strategic intent, technological feasibility, and user experience.

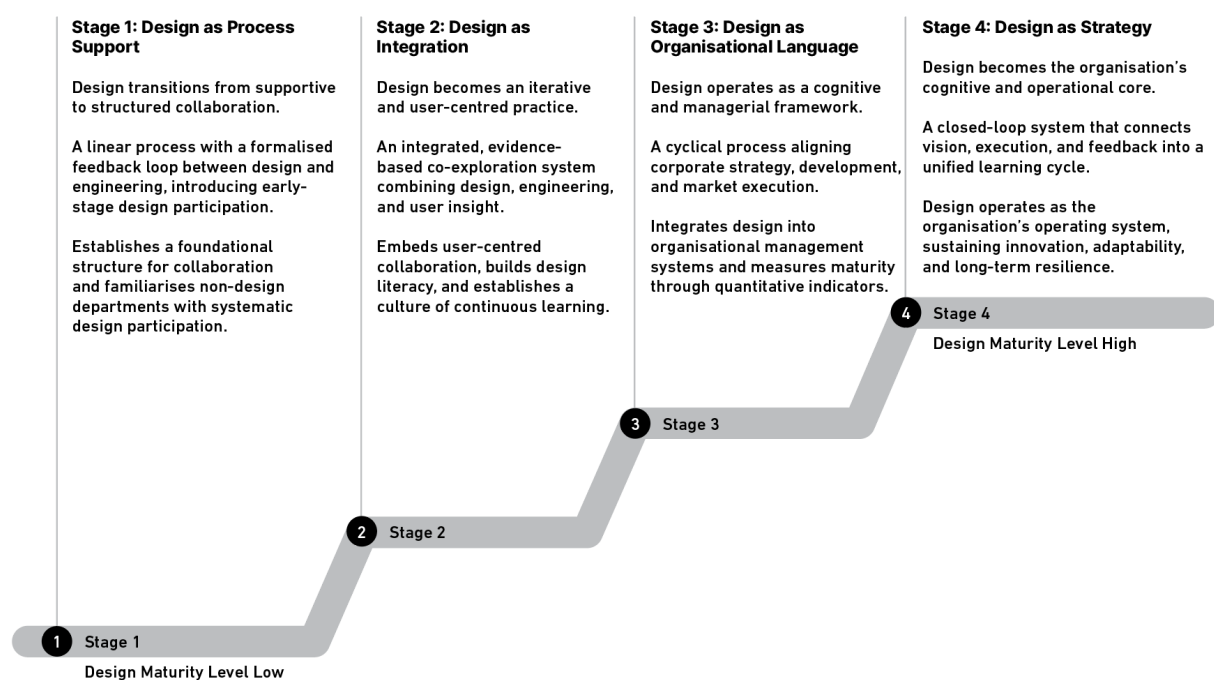


Figure 6. 21: Summary of DDL and the proposed CDPs

Building on the Danish Design Ladder (DDL), the chapter proposed four CDPs that guide OBM firms in progressively embedding design within their product development systems (Figure 7.1).

- **Stage 1 (No Design)** introduces design as a structured visual decision-making tool within engineering-led organisations, creating the foundation for design collaboration and internal learning.
- **Stage 2 (Design as Styling)** formalises cross-functional ideation, user-centred discovery, and iterative testing, transforming design from a supportive to an integrative capability.
- **Stage 3 (Design as Process)** institutionalises design as a cognitive and procedural bridge linking strategy, engineering, and brand, supported by structured R&R frameworks and concurrent validation.
- **Stage 4 (Design as Strategy)** completes the evolution, positioning design as the organisation's cognitive and operational core, a system that unifies vision, technology, and experience into a continuous cycle of learning and innovation.

The final CDPs presented for each stage consolidate design as both a structural and cultural mechanism of transformation. They establish iterative loops connecting planning, execution, and reflection, supported by parallel design–engineering validation systems (EVT–DVT–PVT). Each CDP ensures that design becomes measurable, accountable, and embedded within existing corporate structures, transforming it from a stylistic activity into an operational capability that supports long-term competitiveness.

The evaluation of the CDP by OBM practitioners and design experts confirmed its conceptual coherence and practical feasibility. Participants recognised its ability to balance design creativity with engineering precision, offering a scalable pathway for design maturity. The structured R&R framework, learning-oriented documentation, and process facilitation mechanisms were highlighted as critical for ensuring adoption and cross-functional alignment. Both groups viewed the CDP not merely as a process model but as an organisational learning system that promotes reflection, documentation, and sustained capability growth.

Chapter 6 bridges theoretical discourse and industrial application by reframing design as a strategic infrastructure for innovation within manufacturing-based firms. The four-stage CDP provides a practical and developmental roadmap for OBM firms to evolve toward Stage 4, where design functions as the organisation's operational philosophy, integrating creativity, technology, and strategic learning into a single coherent system. Through this transformation,

design emerges not as an auxiliary discipline but as a cognitive foundation that drives innovation, organisational growth, and sustainable competitive advantage.

Chapter 7. Conclusions

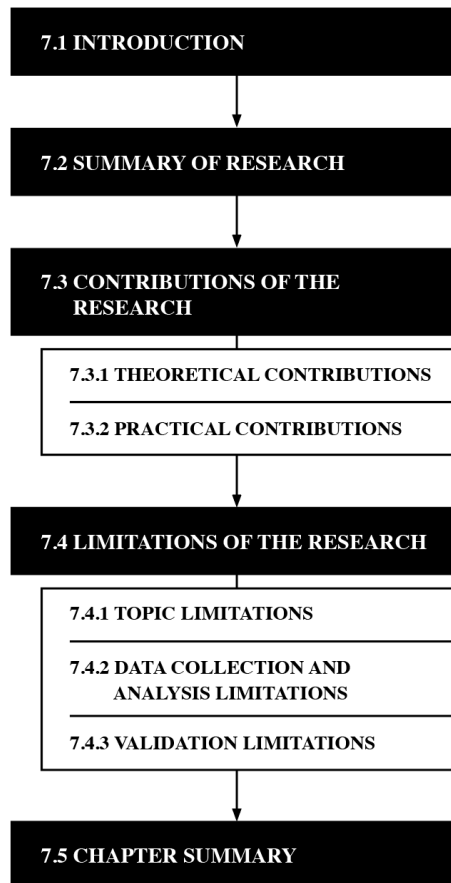
7.1 Introduction

This final chapter concludes the research journey by synthesising its key findings and implications. It revisits the initial research questions and objectives, summarising how each has been addressed through the preceding chapters. The discussion highlights the theoretical, practical, and methodological contributions of the study, articulating how the research extends current understanding of design as an organisational process capability and provides actionable guidance for practice.

The chapter also reflects on the limitations of the study, offering a balanced assessment of its scope and boundaries. Building upon these reflections, it presents recommendations for future research that can further develop, test, and expand the theoretical propositions and practical frameworks proposed in this thesis.

By connecting the conceptual insights, empirical evidence, and applied outcomes established in earlier chapters, this conclusion integrates the entire research trajectory into a coherent narrative. Figure 7.1 provides an overview of the structure of this chapter, illustrating how each section contributes to the final synthesis of the research.

Figure 7.1 Overview of the overall structure and procedural flow of this chapter.



[Figure 7. 1: Chapter map]

7.2 Summary of research

This study aimed to develop a CDP that enables OBM firms and design agencies to achieve more integrated, synergistic cooperation, thereby enhancing design outcomes and strengthening long-term competitiveness. The research was guided by four central questions encompassing the conceptual, organisational, and collaborative dimensions of design processes.

- RQ1.** How have design processes been conceptualised in academic theory, and what limitations emerge when existing models are applied to OBM contexts?
- RQ2.** What organisational and contextual factors shape the design processes of East Asian OBM firms, with particular reference to South Korea?
- RQ3.** How do OBM firms currently implement and manage design processes, and what barriers or challenges inhibit collaboration?

RQ4. How can CDPs be developed for use by OBM firms and design agencies to balance creativity with consistency and ensure both innovation and strategic alignment?

The subsequent sub-sections present a detailed discussion of how each research question was addressed, highlighting the theoretical, empirical, and practical insights derived from the study.

1) RQ 1 - Conceptualisation of design processes in academic theory and their limitations in OBM contexts

Over the past six decades, design process theories have evolved from rational–engineering models to reflective and strategic paradigms. Early frameworks such as Archer’s *Analysis–Synthesis–Evaluation* model (1965) and Ulrich and Eppinger’s *Product Design and Development* (1995) provided procedural clarity but failed to capture the iterative and collaborative dynamics of design in OBM contexts.

Later scholars reframed design as an iterative, interpretive, and knowledge-driven process. Jones (1970) and Cross (2000) highlighted cycles of divergence and convergence, while Lawson (1990) and Schön (1983) viewed design as reflective practice shaped by experience and tacit knowledge. Buchanan (1992) expanded this view into social and cultural domains, positioning design as a meaning-making activity. Yet, these perspectives remained abstract and offered limited operational value for organisations.

Strategic and managerial approaches later bridged design with innovation and learning. Moody (1984) stressed design’s interpretive role, while Wallace and Clarkson (1999) and Unger and Eppinger (2011) integrated engineering rigour with iteration and teamwork. Brown (2009) and Liedtka (2015) advanced *Design Thinking* as an innovation tool, and Blessing and Chakrabarti’s DRM (2009) positioned design as a research-based organisational learning system. These frameworks collectively emphasised design’s strategic potential but exposed a persistent gap between conceptual theory and industrial application.

When applied to OBM firms, four key limitations emerge:

- 1) Contextual mismatch: Western-developed models fit poorly with hierarchical, production-focused East Asian firms (Tsai & Hung, 2010; Zhang & Zhang, 2012).

- 2) Weak cross-functional integration: Limited coordination among design, R&D, and marketing reduces strategic impact.
- 3) Low adaptability: Models such as the Double Diamond (Design Council, 2004) lack flexibility for diverse maturity levels and engineering-led cultures.
- 4) Absence of collaboration mechanisms: Knowledge sharing between firms and external design consultancies remains underexplored (Bruce & Docherty, 1993; Berends et al., 2011).

Existing theories remain conceptually rich but contextually narrow. Embedding design as an organisational capability in OBM firms requires experiential learning and adaptive integration across disciplines. This study therefore proposes a hybrid, context-sensitive design process framework that combines engineering discipline with reflective and collaborative practice to support design-led innovation.

2) RQ2 - Organisational and contextual factors shaping the design processes of East Asian OBM firms

The design processes of East Asian OBM firms are deeply influenced by historical, structural, and cultural legacies rooted in the OEM/ODM production paradigm. Unlike Western firms, where design evolved as a strategic and managerial discipline, East Asian manufacturers have traditionally treated it as a downstream, execution-oriented activity focused on production efficiency rather than innovation (Tsai & Hung, 2010; Zhang & Zhang, 2012). This production-centric mindset, reinforced by hierarchical management and weak cross-functional collaboration, continues to shape how design is institutionalised within OBM firms.

Path dependency from OEM/ODM practices has limited design's strategic role. Competitive advantage once depended on cost control and reliability, not differentiation. Consequently, design was introduced late in the NPD process or outsourced, restricting its capacity to influence early strategic decisions (Chung, 2013; Tsai & Hung, 2010). Moreover, rigid hierarchies and top-down control systems have suppressed bottom-up creativity and hindered communication across design, R&D, and marketing departments (Zhang & Zhang, 2012; Chen & Lyu, 2015), leaving design reactive rather than generative.

The case studies substantiate that the cultural and managerial contexts of East Asian OBM firms continue to exert a profound influence on how design capability develops and is interpreted. Consistent with Hsu and Liang (2014), many firms prioritise procedural conformity and operational control, resulting in incremental rather than exploratory innovation. Case findings reveal that firms such as OBM F, G, and J retain engineering-centric hierarchies in which design remains subordinate to production and cost efficiency, whereas OBM D and E illustrate the early emergence of cross-functional communication and managerial advocacy for design integration. In these transitional settings, leadership commitment and cognitive framing of design as an organisational learning tool, rather than a styling activity, were found to be decisive. The persistence of hierarchical control and the low tolerance for ambiguity hinder iterative design learning and experimentation, reinforcing a functional rather than strategic perception of design.

Despite these constraints, gradual transformation is evident. Leading firms such as OBM A and E now embed design in early-stage planning, supported by reflective feedback systems and dedicated design managers who mediate between creative and managerial domains. Collaborations with global design consultancies, such as OBM A's UK partnership and OBM E's iterative sprint-based model, have facilitated knowledge transfer and process benchmarking. However, others, like OBM G and I, still struggle to balance creative flexibility with manufacturing discipline, reflecting tension between innovation logic and control structures.

Overall, East Asian OBM firms operate within a dual dynamic: traditional structures that constrain creativity, and emerging practices that promote design integration. Progress depends on leadership support, interdepartmental communication, and sustained collaboration with external design partners. To move beyond incremental change, OBM firms must replace functionalist, production-driven models with adaptive, cross-disciplinary processes that align creative exploration with strategic intent. Only through this shift can design evolve from a peripheral activity into a central organisational capability driving innovation and long-term competitiveness.

3) RQ3 - Barriers in implementing and collaborating on design processes in OBM firms, and how they are managed

The main barrier in OBM firms lies in the structural marginalisation of design as a downstream activity rather than a strategic capability. Design is often engaged only after engineering specifications are fixed, preventing early problem framing, concept exploration, and innovation leadership. Consequently, design remains limited to aesthetic refinement instead of driving strategic or user-centred innovation.

This stems from engineering-dominated hierarchies and siloed organisational cultures. Decision-making authority is concentrated in R&D, while design is treated as a service function. Such structures hinder cross-functional communication, restrict user insight from influencing product strategy, and confine design to a reactive role. Low design literacy limited managerial understanding, and rigid schedules further constrain prototyping, iteration, and experimentation, all essential for creative development.

Some firms address these issues through collaboration with design agencies, yet weak process ownership often leads to minimal knowledge transfer and one-off outcomes. More advanced OBM firms are beginning to integrate KPI-based alignment and structured design checkpoints to reconcile creative and strategic objectives. These practices enhance communication, ensure quality consistency, and maintain design influence across the development cycle.

International brand cases demonstrate how such barriers can be overcome through structural integration. Cross-functional task forces involving planning, design, engineering, and marketing from the project's inception foster shared decision-making and coherent strategic direction. Parallel design tracks for short-, medium-, and long-term goals allow firms to balance exploratory creativity with execution discipline. Long-term partnerships with global design consultancies also facilitate benchmarking and knowledge transfer, accelerating design-led innovation.

The key finding is that overcoming these barriers requires redefining design's organisational and temporal position. Design must operate as an upstream process that bridges creative, technical, and strategic domains. When granted early involvement and equal authority, design

fosters collaboration, accelerates innovation, and strengthens organisational learning. Ultimately, positioning design as a continuous integrative capability, rather than a finishing function is essential for OBM firms to achieve sustainable competitiveness and innovation.

4) RQ4 - Structuring a joint design process between OBM firms and design agencies to achieve strategic alignment while balancing creativity and consistency

The study finds that OBM firms can achieve a balance between creativity, consistency, and strategic alignment through a CDP comprising four progressive stages aligned with design maturity. The CDP integrates two complementary logics: a structuring logic that ensures procedural clarity, accountability, and brand coherence, and an adaptive logic that supports flexibility, experimentation, and creative exploration. Together, these enable design to function as an iterative learning framework grounded in shared responsibility and cumulative knowledge.

In early-stage firms (Stage 1–2), design agencies act as mediators, introducing user-centred methods, visual thinking, and rapid prototyping into engineering-led workflows. The focus is on formalising collaboration through defined roles, transparent validation systems (EVT–DVT–PVT), and repeatable design procedures, embedding design as a credible organisational function.

At intermediate maturity (Stage 2–3), the CDP evolves into a co-exploration model, where OBM firms and agencies collaborate continuously through structured cycles of ideation, prototyping, and testing. Creativity is guided by managerial oversight to ensure alignment with business goals, allowing design learning to become an internalised organisational capability rather than an external output.

At advanced stages (Stage 3–4), design functions as a strategic integrator. Agencies act as co-strategists, engaging in early visioning, scenario planning, and brand alignment. Cross-functional teams encompassing design, engineering, marketing, and leadership operate under a unified design-led management structure. Here, creativity and consistency coexist through formalised review systems, experience mapping, and holistic validation processes, ensuring innovation remains strategically coherent.

The study concludes that OBM–agency collaboration must evolve from project-based cooperation to system-level integration, where both parties share decision-making authority, evaluation criteria, and long-term learning goals. When institutionalised through feedback loops, documentation, and knowledge-sharing protocols, design becomes not only a creative driver but a cognitive infrastructure supporting organisational strategy and continuous learning.

In essence, the optimal collaborative structure balances creative autonomy with procedural discipline, enabling design to serve as the connecting mechanism between strategic intent, organisational learning, and market innovation. Through this integrated framework, OBM firms can transform creativity into consistent, value-driven innovation while maintaining strategic alignment across all operational levels.

7.3 Contributions of the research

The principal contribution of this research lies in the development of a practically grounded, theoretically robust framework to enhance collaboration between OBM firms and design practitioners in product development. By introducing the CDP, the study moves beyond descriptive accounts of design management and presents a structured model for integrating and operationalising design as an organisational process capability.

The framework is primarily oriented towards industry, providing OBM firms, particularly those transitioning from OEM and ODM models, with a stage-based pathway to embed design within engineering-led development environments. In doing so, it addresses key challenges such as fragmented design integration and limited internal design capability. At the same time, it repositions design agencies and practitioners as long-term strategic partners rather than external service providers.

Nevertheless, the framework is underpinned by a broader academic contribution. The research reconceptualises design not merely as styling or creative intervention, but as a mechanism for cross-functional integration, organisational learning, and capability development, enabled through strategic collaboration between OBM firms and design agencies. In doing so, the study offers both an actionable industrial framework and a theoretically informed contribution to design management research.

1) Contribution to academia and research

This study reconceptualises design not as a stylistic or functional activity, but as an organisational process capability embedded across strategic, managerial, and cultural dimensions. Moving beyond descriptive accounts, it applies multi-layered qualitative analysis grounded in real-world corporate processes, thereby offering a new theoretical lens for understanding design as an integrated and dynamic construct.

The proposed CDP model provides a robust analytical framework applicable to disciplines such as design management, organisational theory, and innovation studies. It elucidates the interconnections among strategic intent, leadership, organisational culture, and implementation procedures, clarifying how design contributes to decision-making and capability development. Thus, the research refines the analytical scope of design process studies and establishes a theoretically grounded structure that can inform future empirical research.

Furthermore, the study reinterprets the Danish Design Ladder (DDL) to diagnose design maturity within the OBM context and to align each maturity level with corresponding process systems. By linking maturity stages to procedural mechanisms, it transforms the DDL from a static diagnostic tool into a dynamic, evolutionary framework. This advancement enhances theoretical understanding of how design functions as part of organisational learning and strategic development, positioning it as an independent axis within broader organisational research.

2) Contribution to OBM firms

This study provides OBM firms with a clear framework for embedding design within organisational structures and strategic planning. The CDP integrates design reviews into corporate planning and defines collaboration flows among design, engineering, and marketing, ensuring creative activities align with long-term goals.

For small and medium-sized firms, the model offers a stage-based roadmap that enables gradual internalisation of design capability. Through user-centred development, cross-functional collaboration, and iterative validation, design evolves from product styling to a driver of innovation and competitiveness.

By linking each CDP phase to OBM maturity stages (1–4), the study presents a practical method for transforming efficiency-focused operations into user-centred, integrated systems. Ultimately, it demonstrates that design can function as a structural and strategic component within organisational decision-making.

3) Contribution to design agencies

This research clarifies how design agencies can evolve from short-term service providers into long-term strategic partners. Through the CDP, agencies can align their creative outputs with clients' strategic objectives and institutionalise design practices using structured tools, templates, and workshops.

By supporting firms in developing autonomous design capabilities, agencies act as facilitators of organisational transformation rather than external executors. This redefines design as a core organisational process that drives innovation and strategic change, enhancing agencies' professional credibility and long-term value within the industry.

4) Contribution to industrial development

The study demonstrates that design functions as a structural component of industrial innovation. Comparative multi-case analyses identified three determinants of design maturity at the industry level: process institutionalisation, cross-functional collaboration, and strategic leadership commitment. When aligned, these factors enable design to operate as a system that integrates creativity with efficiency.

The proposed CDP also offers practical guidance for standardising processes and reducing capability disparities across sectors. Practitioner evaluations confirm its feasibility, showing that design can serve as an organisational learning framework connecting technical discipline with creative reasoning.

Ultimately, the research positions design as both a driver of firm-level innovation and a foundation for sustaining industrial competitiveness. By embedding design within organisational systems, it advances both organisational learning and the broader evolution of technology-based industries.

7.3.1 Theoretical contributions

The theoretical contribution of this study lies in redefining design not as a creative output or departmental function, but as an organisational process capability. Earlier research largely focused on products, services, or the cognitive and technical abilities of designers (Cross, 2006; Lawson, 2006), thus treating design as outcome oriented. In contrast, this study empirically demonstrates that design operates as a strategic, process-based capability that continuously facilitates learning and innovation. By situating design within Teece's (2007) framework of dynamic capabilities, it shows how design enables organisations to sense opportunities, seize them, and transform resources through structured iteration and reflection.

This research also critiques the linear *stage-gate* model (Cooper, 1990) and the *Double Diamond* model (Design Council, 2006) for failing to reflect the contextual complexities of real organisations. Empirical evidence from East Asian OBM firms demonstrates that these universalist frameworks overlook factors such as hierarchical decision-making, cost-driven priorities, and weak cross-functional collaboration (Dorst, 2011; Kim, 1997; Lee & Lim, 2001). To address this, the proposed CDP offers a model of *structured flexibility* that aligns strategic intent, organisational culture, leadership, and implementation, thereby bridging process theory with organisational and cultural dynamics.

Furthermore, the study identifies that traditional perceptions of design as decorative or stylistic (Heskett, 2005; Verganti, 2009) hinder its institutionalisation. It clarifies that socio-cultural factors and leadership commitment are decisive in embedding design as a sustained organisational capability. By internalising design within socio-cultural systems, the research theoretically explains how design becomes legitimised and operationalised as a strategic process.

Methodologically, the study advances design management research through a multilayered qualitative approach grounded in pragmatism (Morgan, 2007) and critical realism (Bhaskar, 1978). Combining case studies, in-depth interviews, and evaluation workshops, it captures both surface practices and underlying causal mechanisms of organisational behaviour, reflecting the iterative nature of design. This integrative methodology provides a replicable framework for

studying complex organisational contexts (Bruce & Bessant, 2002) and reinforces the theoretical foundations of design management research.

Overall, the study extends and synthesises Teece's (2007) theory of dynamic capabilities, the Design Council's (2006) process model, Verganti's (2009) concept of design-driven innovation, and Morgan's (2007) pragmatic philosophy, establishing design as a structural capability that drives organisational learning, innovation, and strategic transformation

7.3.2 Practical contributions

This study was designed to address both theoretical and practical gaps in understanding how design can be institutionalised as an organisational capability within East Asian OBM firms. Previous research has shown that these firms, shaped by compressed industrialisation, limited brand heritage, and efficiency-oriented management cultures, often struggle to embed design strategically (Hobday, 1995; Gereffi, 1999; Bruce & Bessant, 2002; Best, 2010). Unlike OEM or ODM firms, OBM firms must simultaneously build consumer-oriented brands and integrate design as a driver of innovation and competitiveness.

Accordingly, this research goes beyond describing existing practices to identify how design processes can be improved and institutionalised (Hung, 2008; Lee, Choe, & Kim, 2013; D'Ippolito, Frattini, & Messeni Petruzzelli, 2021). The research design links theory and application through qualitative analysis, ensuring coherence between conceptual development and practical implementation (Teece, Pisano, & Shuen, 1997; Eisenhardt & Martin, 2000).

Empirically developed and validated through practitioner interviews, the CDP provides actionable frameworks at three levels, organisational, industrial, and regional.

At the firm level, the CDP enables OBM firms to embed design systematically within strategic management systems. By incorporating design reviews into planning cycles and clarifying collaboration protocols among design, R&D, and marketing, it ensures alignment between creative activities and long-term objectives. Its stage-based approach offers structured adaptability, balancing creative exploration with procedural discipline, making it particularly

effective for small and medium-sized Korean firms with limited resources (Jeon, 2010; Kim & Eum, 2022).

For design agencies, the CDP establishes a pathway from transactional service delivery to long-term strategic partnership. By aligning design methodologies with client strategies and institutionalising knowledge transfer, agencies can contribute to capability building rather than isolated project outcomes. This repositions agencies as facilitators of organisational transformation and reinforces their legitimacy as strategic partners.

At the industrial level, the study identifies three key enablers of design maturity—process institutionalisation, cross-functional collaboration, and leadership commitment. The CDP serves as a scalable framework for standardising collaborative design practices, bridging capability gaps, and supporting smaller manufacturers in developing design-driven innovation systems. Thus, design emerges as both an organisational learning mechanism and an innovation infrastructure connecting creativity and efficiency.

Although grounded in the Korean context, these findings extend across East Asian economies undergoing the shift from OEM/ODM to OBM (Hobday, 1995; Amsden & Chu, 2003; Gereffi, 1999). As efficiency-based advantages diminish, firms in South Korea, Taiwan, and China increasingly pursue brand-led and design-centred strategies. The CDP thus provides a context-sensitive yet generalisable framework for institutionalising design as a strategic and collaborative capability in late-industrialising economies.

To conclude, this study positions design as a procedural capability that drives innovation and competitiveness beyond the firm level. The CDP functions as a strategic system for OBM firms, a partnership model for design agencies, and a scalable framework for industrial transformation. Grounded in empirical evidence yet regionally transferable, it redefines design as a dynamic process of organisational learning that bridges creativity, structure, and strategy for sustainable competitiveness.

7.4 Limitations of the research

This thesis has made a meaningful academic contribution by advancing both theoretical understanding and practical strategies for the CDPs within OBM firms. However, to ensure transparency and scholarly rigour, it is essential to acknowledge the boundaries that define the scope and applicability of the study's findings. These limitations do not diminish the validity of the research but rather clarify the contextual parameters within which its insights are most relevant and highlight potential directions for future inquiry.

This study primarily focused on OBM firms operating within manufacturing-based industries in East Asia, with particular emphasis on companies headquartered in South Korea. This geographical concentration enabled an in-depth exploration of the organisational mechanisms and contextual dynamics that characterise the OBM transition in East Asian industrial systems. At the same time, however, it inevitably constrained the geographic generalisability of the findings. The South Korean industrial ecosystem is shaped by distinctive institutional features, including hierarchical decision-making structures, technology-centred development cultures, and vertically integrated supply chains. Consequently, the proposed CDP may have been influenced by these regional and cultural particularities.

Nevertheless, the selection of South Korean OBM firms as the primary cases was not based on national specificity but rather on their capacity to represent the universal mechanisms of OBM transition with particular clarity. The Korean industrial structure reflects the general trajectory of OEM–ODM–OBM evolution observed across late-industrialising East Asian economies. Thus, the Korean cases were not chosen to explore regional idiosyncrasies but to provide empirical grounding for the argument that the internalisation of design and brand capabilities constitutes a critical driver for value-chain upgrading within manufacturing sectors (Lee, Bae, & Choi, 2015; Er & Manzakoglu, 2018; Lee, Song, & Kwak, 2015). In this sense, the selected cases possess theoretical representativeness even within a geographically bounded scope.

Accordingly, the study's key principles; strategic alignment, structured adaptability, and cross-functional collaboration are expected to be applicable across diverse industries and regions. However, in contexts such as Western economies, service sectors, and digital industries, where organisational cultures and innovation dynamics differ substantially, certain contextual adaptations may be required. Moreover, as the study concentrated on CDP at the organisational level, it did not address macro-level factors such as design policy or the national innovation ecosystem.

This topic-specific focus served to sharpen the analytical scope and deepen theoretical insight, while simultaneously underscoring the need for future research to extend toward non-Korean firms, multicultural organisational settings, and cross-national comparative studies to test the process' broader applicability.

Data collection and analysis limitations

This study adopted a multi-method qualitative approach that integrated case studies, in-depth interviews, and participatory observation. While this approach effectively captured the interpretive depth and contextual richness of design collaboration, several methodological constraints should be acknowledged.

First, although the multi-case study design provided robust empirical grounding, the scope of assessment rather than the number of cases presented a limitation. Because the research concentrated on specific sectors and firms with varying design maturity levels, it was not possible to assess the full spectrum of industrial diversity within the broader OBM landscape. Consequently, this study's findings are intended for analytical generalisation rather than statistical inference, offering theoretically transferable insights applicable to comparable industrial and cultural contexts (Yin, 2018).

Second, access to internal and confidential organisational data, including proprietary design documentation and strategic planning materials was restricted. Limited observation of executive-level meetings and strategic design discussions necessitated greater reliance on interview data and participatory field notes. While this approach maintained interpretive validity, it inevitably constrained the level of analytical depth attainable in examining decision-making processes.

Third, the self-reported nature of interview data introduced potential risks of selective recall and social desirability bias (Podsakoff et al., 2003). To mitigate these risks, methodological triangulation, member checking, and reflexive documentation were employed to enhance reliability and interpretive coherence. Nevertheless, complete objectivity is unattainable within qualitative inquiry due to its inherently interpretive orientation.

Furthermore, evaluation interviews with four design and business experts were conducted to assess the practical relevance and applicability of the proposed CDP. However, due to logistical and temporal constraints, a broader panel of reviewers could not be included, which limited the diversity of assessment perspectives.

Despite these constraints, the limitations did not undermine the core purpose of this study, to explore and identify mechanisms for strengthening CDPs within OBM firms. Rather, they underscore the need for future research to expand empirical scope through longitudinal and cross-sectoral investigations, thereby validating and refining the theoretical and practical contributions established in this thesis.

Validation limitations

The validation of the proposed CDP in this study was primarily conducted through qualitative expert evaluation, employing the principles of pragmatic validity and contextual fit as core assessment criteria. This approach offered nuanced interpretive insights into how the CDP operated within actual organisational environments, how practitioners perceived its feasibility and value, and how it aligned with the realities of collaboration between OBM firms and design agencies.

However, the scope of validation was necessarily limited, which constrains the external validity and breadth of empirical confirmation. Since the evaluation involved a small group of expert participants, the findings should be understood as analytically generalisable rather than statistically representative (Yin, 2018). The insights derived from these evaluations therefore serve as exploratory evidence that validates the conceptual robustness and practical coherence of the CDP within comparable contexts, rather than as claims of universal applicability.

Additionally, while expert evaluations offered valuable practitioner-oriented perspectives, the absence of large-scale or longitudinal validation prevented the observation of how the CDP performs over extended implementation cycles. Future research should therefore incorporate cross-sectoral and longitudinal studies, testing the process within varied organisational settings and cultural contexts to assess its long-term adaptability and resilience.

Despite these constraints, this research successfully demonstrates the practical validity and organisational feasibility of the CDP. By verifying how the process integrates with real-world design management systems and supports collaborative performance, the study establishes a strong empirical foundation for further theoretical advancement and iterative empirical revalidation. These findings contribute meaningfully to the ongoing development of CDP theory, particularly within OBM contexts and broader East Asian industrial environments.

7.5 Chapter summary

This chapter synthesises the research by interlinking its three core dimensions, theoretical development, empirical investigation, and practical application. The central aim of the study was to examine how design can evolve from a creative or aesthetic function into a collaborative organisational process capability. Through systematic theoretical and empirical analysis, it proposed the CDP, a structured yet adaptive framework enabling OBM firms and design agencies to collaborate effectively across varying levels of design maturity. The CDP integrates strategic intent, organisational culture, and operational structure, providing a model that is analytically rigorous, empirically validated, and practically applicable.

At the academic level, the research redefines design as an organisational and strategic capability, expanding the focus of design scholarship beyond output-oriented or stylistic perspectives. It bridges previously fragmented domains of design management, innovation theory, and organisational learning, showing how design functions as a dynamic capability that drives sensing, seizing, and transforming processes within firms. Methodologically, the study combines pragmatist and critical realist approaches, enabling analysis of both observable organisational behaviours and underlying causal mechanisms shaping collaborative design practice.

Practically, the study offers actionable insights for OBM firms, design agencies, and the wider industry. OBM firms gain a structured pathway to internalise design through process integration, design review systems, and cross-functional collaboration. Design agencies acquire a framework for long-term partnership, knowledge transfer, and cultural mediation, repositioning themselves as strategic collaborators rather than service providers. At the

industrial level, the CDP provides a scalable mechanism for enhancing design maturity, standardising processes, and reducing capability disparities across East Asian manufacturing sectors. Collectively, these outcomes demonstrate how theoretical insight can translate into organisational learning, sustained innovation, and design-led competitiveness.

The chapter also acknowledges research limitations, including the limited access to proprietary organisational data, the narrow validation scope, and the geographic focus on South Korea. These define the contextual boundaries of the study while suggesting directions for future research, such as cross-sectoral and longitudinal validation, and comparative application across diverse cultural and industrial contexts.

In conclusion, this thesis establishes both the theoretical and practical foundation for understanding design as a collaborative, strategic process capability. By presenting a coherent theoretical framework, robust empirical evidence, and a validated process, it demonstrates how design can serve as a transformative organisational process connecting creativity, structure, and strategy. Ultimately, the study positions design as a catalyst for organisational learning, continuous innovation, and sustainable competitiveness within a rapidly evolving global economy.

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Appendix 1: Questions for in-depth interviews with design agencies and international brands

In-depth interviews – Design agency

Questionnaires

Introduction

1. Describe your company's design process end to end. What are the key activities?
2. Does your company's design process get integrated to the client company's overall NPD process? Or do you think it plays independently?
3. In general, what kinds of information does the client company provides you in order to understand the whole view of new product development, such as purpose and goal for the project? What information do you need to receive from the client company?

Experience working with OBM firms

4. Based on your experience, what design culture or depth of understanding in design that OBM firms have?
5. When you are working with OBM firms (which does not have design team or lack of experience in design), what are your requirements or responsibilities as a designer (design consultant) in terms of new product design?
6. How these different from those of in-house designers at international brands companies?
7. Do you working with single department during the project or in close collaboration with other functional department or with other external organizations? (Who involves in design project?)
8. Where is design process do you repeat or rework? How often, and why?
9. How does your design work, process and communication are closely integrated or linked with overall corporate management principle?

OBM firms and international brands

10. What are the main focuses or subjects/major issues that OBM firms during the design process?
11. How does it different from international brands (in-house design team)?

About current design process

Appendix 2: Questions for in-depth interviews with OBM firms

In-depth interviews – OBM firms

Questionnaires

Introduction

1. Introduce a role of your division in the organization and what is your role and responsibility during the new product development (NPD) process? Which stage do you involve in?
2. Who or what division control/manage design until the project it completed?

About NPD process and design process

3. Describe the NPD process end to end. What are the key activities of the design process during the NPD process?
4. How external design agency integrally involved in the NPD process? In which stage of the process they involve?
5. How do you define design work scope? What do you think the requirements or responsibilities of external designers in terms of NPD process? What kinds of information do you provide to external design agency?
6. Do you working with single department during the project or in close collaboration with other functional department or with other external organizations? (Who involves in design project?)
7. How do you monitor design development process and list your progress, shortcomings, and develop action plans to address those areas in need?
8. How quick does your team or company make a decision regarding on consolidating design direction?
9. What are the biggest challenges for you to work with external design team?

About current design process

10. Based on your experience, is the current design process effective and efficient in your results?
11. What parts of the design process do you seek to eliminate, and why?
12. What parts of the design process help you to progress NPD the most?

Example: The design process and activities - use this chart to complete during the interviews
During the interview probing questions will cover key design activities and construction of projects involve on each stage. It will also cover the relationship between the external design agency and the internal project team.

Visual material for in-depth interview

Example: The design process and activities - use this chart to complete during the interviews									
During the interview probing questions will cover key design activities and construction of projects involve on each stage. It will also cover the relationship between the external design agency and the internal project team.									
External design agency	• Define problem • Consumer needs understanding • Observational research • Opportunity sizing and scaling • Consumer insight study and research • Clustering solutions to opportunities • Generate visual concepts • Brand & positioning hypothesis • Business opportunity hypothesis • Refinement & development of the designs in CAD • Develop material and finish choices • Produce renders of interior and exterior for each concept • Prototyping • Complete final refinement of final design in discussion with engineers or project leader • Refine 3D CAD data • Finalise material and finish choices • Produce artwork for all printed graphics • Develop detail design • Deliver the final design								
	Who involves	Designer	Designer	Designer	Designer	Designer			
Key activities	Planning Concept design System level design Detail design iterations Integration and test Release • Consideration of the existing problems and associated with existing solutions, costs, and marketplace needs • Technical feasibility • Conceptual engineering • Establishing design requirements • Preliminary design based on the specifications • Define overall system configuration, schematics, diagrams, and layouts • Manufacturing model selection • Product technology • Production								
	OBM firm's NPD project team								
Key activities	Senior executives Researcher Engineering designer Marketing Product planning • Develop usability, durability etc.								
	Who involves	Senior executives	Researcher	Engineering designer	Engineering designer	Senior executives	Engineering designer		
Key activities	Researcher Engineering designer Product planning • Develop usability, durability etc.								
	Who involves	Researcher	Engineering designer	Product planning	Engineering designer	Senior executives	Engineering designer		
Key activities	Product planning • Develop usability, durability etc.								
	Who involves	Product planning							

Appendix 3: Map out the findings from in-depth interviews

International Brands													
Phase	1 Preparation	2 Product planning / Concept definition	3 Initial Concept Generation	4 Design Embodiment	5 Design Prototyping	6 Design Finalisation	7 Product Verification	8 Product Development Planning	9 Quality Control Test	10 Production Planning	11 Functional/ Mechanical Test	12 Pilot Production	13 Mass Production
Description	xxxxxxx	Define project and business unit needs Create product description	Create preliminary design	Refine design detail	Build and test design prototypes	Detail and optimise design	Demonstrate product performance	xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx	xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx	xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx	Demonstrate product performance	Demonstrate mass production quality and performance	Launch product
Inter A	Product Planning Team xxxxxx	Product Planning Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx
Inter B	Product Planning Team xxxxxx	Product Planning Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx
Inter C	Product Planning Team xxxxxx	Product Planning Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx	Design Team xxxxxx

OBM firms

Phase	1. Product Planning	2. Create I/F team	3. Initial Concept Generation	4. Design Embodiment	5. Design Prototyping	6. Design Finalisation	7. Prototype Sample Test 1, 2	8. Mechanical Engineering Specification	9. Product Verification	10. Product Development Planning	11. Quality Control Test	12. Production Planning	13. Functional/ Mechanical Test	14. Qualification Test	15. Pilot Production	16. Mass Production
Description	Define project and business unit needs	xxx	Create preliminary design	Refine design detail	Build and test design/prototypes	Detail and optimise design		Demonstrate product performance	xxxxxx xxxxxx xxxxxx	xxxxxx xxxxxx xxxxxx	xxxxxx xxxxxx xxxxxx	xxxxxx xxxxxx xxxxxx	Demonstrate product performance		Demonstrate mass production quality and performance	Launch product
OBM C	Product Planning Team - Identify product specification - Identify project agency - Identify project timing, resources - Create initial product architecture - Assign a project manager technical failure modes	Product Planning Team - Identify critical-to-quality specs - Assess and select external design agency - Document product development team members - Identify project manager	External Design Agency - Desk research on cultural and market trends - Capture the latest products in the market - Target consumer research - Analyse consumer needs - Brainstorm research results	External Design Agency - Review design internally - Enhance design detail area linking USP's - Refine the physical & user oriented design language - Build initial 3D CAD modelling	N/A	Design Team - Complete design 3D CAD data - Develop high-quality 3D rendering - Finalise specification of colour/material and finishes	R&D	R&D	R&D	R&D	R&D	R&D	R&D	R&D	R&D	R&D
	R&D xxxx xxxx xxxx - Generate initial 3D rendering concepts - Conduct a preliminary design review					R&D - Draft technical documentation - Complete engineering documentation										
OBM D	Product Planning Team - Identify critical-to-quality specs - Identify project agency - Identify project timing, resources - Create initial product architecture - Assign a project manager technical failure modes	Product Planning Team - Identify critical-to-quality specs - Assess and select external design agency - Document product development team members - Identify project manager	External Design Agency - Desk research on cultural and market trends - Capture the latest products in the market - Target consumer research - Analyse consumer needs - Brainstorm research results	External Design Agency - Review design internally - Enhance design detail area linking USP's - Refine the physical & user oriented design language - Build initial 3D CAD modelling	In-house	Design Team - Complete design 3D CAD data - Develop high-quality 3D rendering - Finalise specification of colour/material and finishes	In-house	In-house	In-house	In-house	In-house	In-house	In-house	In-house	In-house	In-house
						Design Team - Draft technical documentation - Complete engineering documentation										
	Product Planning Team - Identify critical-to-quality specs - Assess and select external design agency - Document product development team members - Identify project manager	Product Planning Team - Identify critical-to-quality specs - Assess and select external design agency - Document product development team members - Identify project manager	External Design Agency - Desk research on cultural and market trends - Capture the latest products in the market - Target consumer research - Analyse consumer needs - Brainstorm research results	External Design Agency - Review design internally - Enhance design detail area linking USP's - Refine the physical & user oriented design language - Build initial 3D CAD modelling	In-house	Design Team - Complete design 3D CAD data - Develop high-quality 3D rendering - Finalise specification of colour/material and finishes	In-house	In-house	In-house	In-house	In-house	In-house	In-house	In-house	In-house	In-house
						Design Team - Draft technical documentation - Complete engineering documentation										

Appendix 4: Findings from in-depth interviews of international brands and design agencies

Findings from in-depth interviews

Processes

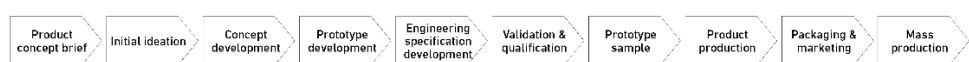
International brand A



International brand B



International brand C



Roles and responsibilities

Table 1: A summary of the disciplines and teams of international brands which involve in the NPD process

Stages	Cases	Company A	Company B	Company C
Planning		Product Planning or Design	Product Planning or In-house Design or External Design	Product Planning or Design
Create T/F team	X		Product Planning or In-house Design or External Design	X
Initial design dev.	Design		Design	Design
Design embodiment	Design		Design	Design
Prototype	Design		Design, R&D	Design, R&D
Product dev. planning	R&D		Design, R&D	R&D
Quality control test	R&D		R&D	R&D
Production planning	R&D		R&D	R&D
Functional/ mechanical test	Design, R&D		Design, R&D	Design, R&D
Mass production/ launch	Design, R&D		Design, R&D	Design, R&D
Marketing, advertising	Product Planning, MKT, Sales		Product Planning, MKT, Sales	Product Planning, MKT, Sales
Packaging design	Design		MKT, Design	MKT, Design



Findings from in-depth interviews

Processes

International brand A



International brand B



International brand C



Appendix 5: Findings from in-depth interviews of OBM firms

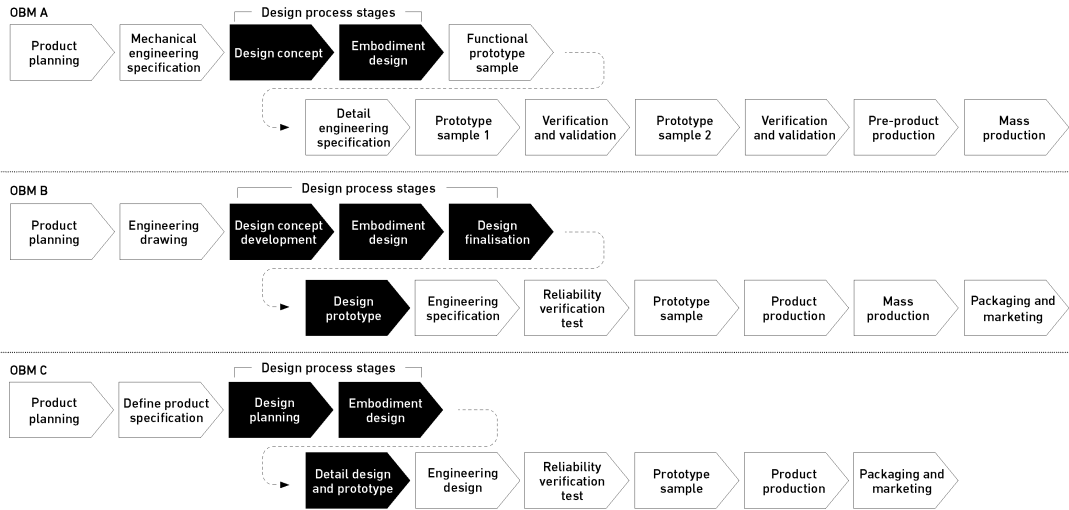
Roles and responsibilities

Table : A summary of the disciplines and teams of OBM firms involved in the NPD process

Stages	Cases		
	OBM A	OBM B	OBM C
Planning	R&D	Product planning	Product planning
Create T/F team	R&D	Product planning or Design	Product planning or R&D
Initial design dev.	External design agency	In-house or external design agency	In-house or external design agency
Design embodiment	External design agency	In-house or external design agency	In-house or external design agency
Design prototype	X	In-house or external design agency	In-house or external design agency
Prototype sample 1, 2	R&D	R&D, In-house design	R&D, In-house design
Mechanical engineering specification	R&D	R&D	R&D
Product dev. planning	R&D	Design, R&D	R&D
Quality control test	R&D	R&D	R&D
Production planning	R&D	R&D	R&D
Functional/ mechanical test	R&D	R&D	R&D



Findings from in-depth interviews



Appendix 6: Map out findings from the participatory observation of OBM firms

SINDON			
Product development plan 06/10/2021			
Activity	Task	Description	Est. Start
Mechanical	Design Verification Testing	Detailed Design documentation, Electronics/PID designed, initial vbo, 1st product prototype, 1st engineering model	21/02
	Design Verification Testing	Detailed Functional plan based on 2D-3D products for integration and DVT (including identification, CE mark approval)	26/04
	Production Verification Testing	Detailed Manufacturing plan batch, documentation package for running the product & PVT	30/03
Electrical	Internal Design	1. Electrical Design	17/02
	Schematic Design	2. Schematic Design	18/02
	PCB Design	3. PCB Design	19/02
	Functional Test	4. Functional Test	20/02
	Schematic Design	5. Schematic Design	21/02
	PCB Design	6. PCB Design	22/02
	Functional Test	7. Functional Test	23/02
	Schematic Design	8. Schematic Design	24/02
	PCB Design	9. PCB Design	25/02
	Functional Test	10. Functional Test	26/02
Software	Internal Design	1. Software Design	17/02
	Schematic Design	2. Software Design	18/02
	PCB Design	3. Software Design	19/02
	Functional Test	4. Software Design	20/02
	Schematic Design	5. Software Design	21/02
	PCB Design	6. Software Design	22/02
	Functional Test	7. Software Design	23/02
	Schematic Design	8. Software Design	24/02
	PCB Design	9. Software Design	25/02
	Functional Test	10. Software Design	26/02
Mechanical	Internal Design	1. Mechanical Design	17/02
	Schematic Design	2. Mechanical Design	18/02
	PCB Design	3. Mechanical Design	19/02
	Functional Test	4. Mechanical Design	20/02
	Schematic Design	5. Mechanical Design	21/02
	PCB Design	6. Mechanical Design	22/02
	Functional Test	7. Mechanical Design	23/02
	Schematic Design	8. Mechanical Design	24/02
	PCB Design	9. Mechanical Design	25/02
	Functional Test	10. Mechanical Design	26/02

Industrial software			
Activity	Task	Description	Est. Start
Mechanical	Internal Design	1. Mechanical Design	17/02
	Schematic Design	2. Mechanical Design	18/02
	PCB Design	3. Mechanical Design	19/02
	Functional Test	4. Mechanical Design	20/02
	Schematic Design	5. Mechanical Design	21/02
	PCB Design	6. Mechanical Design	22/02
	Functional Test	7. Mechanical Design	23/02
	Schematic Design	8. Mechanical Design	24/02
	PCB Design	9. Mechanical Design	25/02
	Functional Test	10. Mechanical Design	26/02
Software	Internal Design	1. Software Design	17/02
	Schematic Design	2. Software Design	18/02
	PCB Design	3. Software Design	19/02
	Functional Test	4. Software Design	20/02
	Schematic Design	5. Software Design	21/02
	PCB Design	6. Software Design	22/02
	Functional Test	7. Software Design	23/02
	Schematic Design	8. Software Design	24/02
	PCB Design	9. Software Design	25/02
	Functional Test	10. Software Design	26/02
Mechanical	Internal Design	1. Mechanical Design	17/02
	Schematic Design	2. Mechanical Design	18/02
	PCB Design	3. Mechanical Design	19/02
	Functional Test	4. Mechanical Design	20/02
	Schematic Design	5. Mechanical Design	21/02
	PCB Design	6. Mechanical Design	22/02
	Functional Test	7. Mechanical Design	23/02
	Schematic Design	8. Mechanical Design	24/02
	PCB Design	9. Mechanical Design	25/02
	Functional Test	10. Mechanical Design	26/02

Industrial design			
Activity	Task	Description	Est. Start
Mechanical	Internal Design	1. Mechanical Design	17/02
	Schematic Design	2. Mechanical Design	18/02
	PCB Design	3. Mechanical Design	19/02
	Functional Test	4. Mechanical Design	20/02
	Schematic Design	5. Mechanical Design	21/02
	PCB Design	6. Mechanical Design	22/02
	Functional Test	7. Mechanical Design	23/02
	Schematic Design	8. Mechanical Design	24/02
	PCB Design	9. Mechanical Design	25/02
	Functional Test	10. Mechanical Design	26/02
Software	Internal Design	1. Software Design	17/02
	Schematic Design	2. Software Design	18/02
	PCB Design	3. Software Design	19/02
	Functional Test	4. Software Design	20/02
	Schematic Design	5. Software Design	21/02
	PCB Design	6. Software Design	22/02
	Functional Test	7. Software Design	23/02
	Schematic Design	8. Software Design	24/02
	PCB Design	9. Software Design	25/02
	Functional Test	10. Software Design	26/02
Mechanical	Internal Design	1. Mechanical Design	17/02
	Schematic Design	2. Mechanical Design	18/02
	PCB Design	3. Mechanical Design	19/02
	Functional Test	4. Mechanical Design	20/02
	Schematic Design	5. Mechanical Design	21/02
	PCB Design	6. Mechanical Design	22/02
	Functional Test	7. Mechanical Design	23/02
	Schematic Design	8. Mechanical Design	24/02
	PCB Design	9. Mechanical Design	25/02
	Functional Test	10. Mechanical Design	26/02

Software			
Activity	Task	Description	Est. Start
Mechanical	Internal Design	1. Mechanical Design	17/02
	Schematic Design	2. Mechanical Design	18/02
	PCB Design	3. Mechanical Design	19/02
	Functional Test	4. Mechanical Design	20/02
	Schematic Design	5. Mechanical Design	21/02
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	Functional Test	10. Mechanical Design	26/02

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Activity	Task	Description	Est. Start
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	PCB Design	3. Mechanical Design	19/02
	Functional Test	4. Mechanical Design	20/02
	Schematic Design	5. Mechanical Design	21/02
	PCB Design	6. Mechanical Design	22/02
	Functional Test	7. Mechanical Design	23/02
	Schematic Design	8. Mechanical Design	24/02
	PCB Design	9. Mechanical Design	25/02
	Functional Test	10. Mechanical Design	26/02

Software			
Activity	Task	Description	Est. Start
Mechanical	Internal Design	1. Mechanical Design	17/02
	Schematic Design	2. Mechanical Design	18/02
	PCB Design	3. Mechanical Design	19/02
	Functional Test	4. Mechanical Design	20/02
	Schematic Design	5. Mechanical Design	21/02
	PCB Design	6. Mechanical Design	22/02
	Functional Test	7. Mechanical Design	23/02
	Schematic Design	8. Mechanical Design	24/02
	PCB Design	9. Mechanical Design	25/02
	Functional Test	10. Mechanical Design	26/02
Software	Internal Design	1. Software Design	17/02
	Schematic Design	2. Software Design	18/02
	PCB Design	3. Software Design	19/02
	Functional Test	4. Software Design	20/02
	Schematic Design	5. Software Design	21/02
	PCB Design	6. Software Design	22/02
	Functional Test	7. Software Design	23/02
	Schematic Design	8. Software Design	24/02
	PCB Design	9. Software Design	25/02
	Functional Test	10. Software Design	26/02
Mechanical	Internal Design	1. Mechanical Design	17/02
	Schematic Design	2. Mechanical Design	18/02
	PCB Design	3. Mechanical Design	19/02
	Functional Test	4. Mechanical Design	20/02
	Schematic Design	5. Mechanical Design	21/02
	PCB Design	6. Mechanical Design	22/02
	Functional Test	7. Mechanical Design	23/02
	Schematic Design	8. Mechanical Design	24/02
	PCB Design	9. Mechanical Design	25/02
	Functional Test	10. Mechanical Design	26/02

Software			
Activity	Task	Description	Est. Start
Mechanical	Internal Design	1. Mechanical Design	17/02
	Schematic Design	2. Mechanical Design	18/02
	PCB Design	3. Mechanical Design	19/02
	Functional Test	4. Mechanical Design	20/02
	Schematic Design	5. Mechanical Design	21/02
	PCB Design	6. Mechanical Design	22/02
	Functional Test	7. Mechanical Design	23/02
	Schematic Design	8. Mechanical Design	24/02
	PCB Design	9. Mechanical Design	25/02
	Functional Test	10. Mechanical Design	26/02
Software	Internal Design	1. Software Design	17/02
	Schematic Design	2. Software Design	18/02
	PCB Design	3. Software Design	19/02
	Functional Test	4. Software Design	20/02
	Schematic Design	5. Software Design	21/02
	PCB Design	6. Software Design	22/02
	Functional Test	7. Software Design	23/02
	Schematic Design	8. Software Design	24/02
	PCB Design	9. Software Design	25/02
	Functional Test	10. Software Design	26/02
Mechanical	Internal Design	1. Mechanical Design	17/02
	Schematic Design	2. Mechanical Design	18/02
	PCB Design	3. Mechanical Design	19/02
	Functional Test	4. Mechanical Design	20/02
	Schematic Design	5. Mechanical Design	21/02
	PCB Design	6. Mechanical Design	22/02
	Functional Test	7. Mechanical Design	23/02
	Schematic Design	8. Mechanical Design	24/02
	PCB Design	9. Mechanical Design	25/02
	Functional Test	10. Mechanical Design	26/02

Software			
Activity	Task	Description	Est. Start
Mechanical	Internal Design	1. Mechanical Design	17/02
	Schematic Design	2. Mechanical Design	18/02
	PCB Design	3. Mechanical Design	19/02
	Functional Test	4. Mechanical Design	20/02
	Schematic Design	5. Mechanical Design	21/02
	PCB Design	6. Mechanical Design	22/02
	Functional Test	7. Mechanical Design	23/02
	Schematic Design	8. Mechanical Design	24/02
	PCB Design	9. Mechanical Design	

Appendix 7: Questions for assessment with Experts and OBM firm

Design Experts 1

Section I. Evaluation of design process usability and interpretive understanding

Question: To what degree do you agree or disagree with the following statements regarding the optimised design processes? (1 = Not at all, 5 = Fully)

No.	Statement	1	2	3	4	5	Comments
1	The structure and sequence of the design processes are clear and easy to understand.						
2	The design process diagrams effectively communicate design intent and workflow logic.						
3	The terminology used in the process stages is consistent and easily interpretable across teams.						
4	The process is practical to implement within existing organisational routines and project structures.						
5	The design process supports team coordination and shared understanding between OBM practitioners and design consultants.						
6	The process facilitates reflective learning and knowledge transfer within the organisation.						
7	The model allows flexibility for contextual adaptation without losing its conceptual coherence.						

Comments

Design Experts 1

Section II. Application and organisational integration

Question: Please evaluate the degree to which the proposed processes align with your organisational context and collaborative practices. (1 = Not at all, 5 = Fully)

No.	Statement	1	2	3	4	5	Comments
1	The design process aligns with the current design culture and project management practices of your organisation.						
2	The model helps integrate design functions with other departments (e.g., marketing, R&D, production).						
3	The design process supports collaborative decision-making between internal and external teams.						
4	The model can be scaled or customised depending on project size or maturity level.						
5	The design process enables clear communication of design responsibilities between OBM firms and design consultancies.						
6	The design process reflects how design activities contribute to broader organisational learning and strategy formation.						

Comments

Design Experts 1

Section III. Evaluation of four maturity-level models (derived from the design ladder)

For each model below, please indicate:

- (a) The degree to which it would work in your organisational context;
(b) Key strengths and weaknesses from your perspective.

Model	1	2	3	4	5	Comments
Model 1 – Design as styling and function Focused on product appearance and functionality with limited integration.						
Model 2 – Design as process support Applied as a structured but supportive tool within development projects.						
Model 3 – Design as strategic process Applied as a structured but supportive tool within development projects.						
Model 4 – Design as transformation Design embedded as a strategic platform for organisational identity and innovation.						

Design Experts 1

Follow-up questions:

1. Which model best represents your organisation's current design maturity?
2. Which model do you consider the most desirable long-term target?
3. What organisational or cultural factors enable or constrain movement between these levels?

Section IV. Reflective insights and qualitative comments

1. To what extent do you find the proposed design process realistic and useful within your actual work environment or project operations?

(For example: does the structure fit your workflow, and is it practically feasible to implement?)

2. When applying this process to collaborative projects between OBM firms and external design consultancies, what kinds of challenges or constraints do you anticipate?

(For instance: time, decision-making structure, communication flow, or role allocation issues.)

3. Are there any parts of the process—such as stages, terminology, or descriptions—that you think require additional clarification or refinement?

(For example: ambiguous steps, overlapping phases, or procedures difficult to apply in practice.)

4. In your view, how could this process be improved to better support creative problem-solving and knowledge sharing within your organisation or project teams?

(For instance: by enhancing feedback mechanisms, collaboration methods, or internal learning structures.)

Appendix 8: Gathering data from interviews v1.0

[illegible]

Appendix 9: Identifying themes emerging from interviews v1.2

[illegible]

Identifying themes emerging from interviews					
Collaborative	Process adaptability	New mindset (sustainability, human friendly tech etc)	Design leadership		
Flexibility	Data interaction	Organisational learning			
Strategic alignment	Quality				
Easy connect/integrated	Time	Strategic alignment			
Collaborative	Easy connect/integrated				
Adaptability	Cultural aspects				
Self-driving - accessible weight saving of 50%					
Antennas on aircraft	Will people even own cars in the future?		Car ownership will be recreational		
Machine learning to improve algorithms					
Sensors in everything					
Swap parts before they need replacing - preemptive maintenance					
Machine learning that complements the human, rather than replacing it	Not just health conscious, but mind conscious	Innovation in the back end has made the front end stable. The front end is not necessarily as innovative	EV & Autonomous		
AR best when it's under the surface e and supporting human behaviour rather than fully sucking people in	There is a move from convenience, speed and efficiency to greater planning and a less ad hoc approach to life Convience economy to conscious economy is shaping values and choices Tension in opposign trends - the future will need to resolve these tensions		A need for the best batteries and other ways to reduce consumers range anxiety A need for noise to let pedestrians know EVs are approaching		
	there is a growth in peoples' ambition for their own personal development and there are many tech tools to support this need		Me time in the car		
AR VR, there have been some great advancements, including with just audio	Monitoring with cameras and microphones for an easy connected home		A car to encourage better driving		
Infant canvas, rather than a fully immersive	Changing attitudes to health data and privacy	A lot of the tech is already there and people don't know how to use it.	Lower emission technology tech to control the sonic environment within the car. Noise cancelling, material surfaces		
Real estate - VR fitness game	Better interfaces in vehicles are more than just a screen area.	Directional audio within a vehicle.			
Rt Blackboard design - allowing lots of different inputs and outputs - different modes of interaction	Voice stuff is getting better - the ability to hold a conversation. Wobot				
Bio hacking has given us a better awareness of ourselves	collaboration tech to interact with others and to learn and improve				
Assess your own gut bacteria by using microchips inside pills to monitor the gut	Interact with information better, as there is so m uch coming at us all the time				
Brain scanning to track thoughts - biohacking to get you back to a better state.	Everything has become a bit more intentional - things are going to be less casual.				
Nuro link tracking thoughts and sending magnetic waves to the brain to affect your mood - "curated feelings"	Meditative state while driving				
Meditation head set to monitor when you are in a meditative state.	Car as meeting room				
Advice on how to be more healthy					
Combined input eg visual analysis, lie detectors and gesture detectors - look at Google Stio					
People worried about security tracking issues but willing to give up data in exchange for a good value proposition					
Interested in "calm interfaces" and blended interfaces including tactility					
Voice interface are much better but they are still very transactional. Can we get to conversational?					
(check out Wobot App and Offer ai					

Appendix 10: Grouping common themes v2.0

Grouping common themes									
Collaborative	Process adaptability	New mindset: Sustainability, human-friendly tech etc.	Design leadership						
Flexibility	Data interaction	Organisational learning							
Strategic alignment	Quality								
Easy connect/integrated	Time	Strategic alignment							
Collaborative	Easy connect/integrated								
Adaptability	Cultural aspects								
Collaborative	Flexibility	Strategic alignment	Easy connect/integrated	Collaborative	Adaptability	Process adaptability	Data interaction	Quality	
Conversational interaction with an AI assistant, across different platforms	Context driven, more responsive to behavior: MD	Bioelectric health and wellness monitoring MD	Blended bioelectricity for identification MD	tech-changing the way that we build cars from start-ups with different processes to new material CP	MT breathable textiles CP	Passengers own device can be the continuum with the airlines relationship with the passenger AM	IFE is more than just an entertainment device, it's digital signage: AM		
Connectivity - seamless, Link all the elements, IoT onboard the aircraft, that allows for a really personalised experience	Interactions moving into the background - moving technology far away, and simplicity to the forefront: MD		stimulated feedback through the control to make flying different aircraft more familiar IW	3D printing - the ability to produce lower volumes CP	Smart textiles laid over screens CP	Enterprising small touches of information through multiple channels (voice, visual, touch) MD	Cameras as health monitoring, or even sensing mood AM	Services are becoming more important than hardware: MD	Why is a car useful? Does Automotive need to move to new service business models to enable people to have the right kind of vehicle for the moment when they need it? CP
Machine learning to improve algorithms	Technology moving to the background, MD	Sensors in everything BA	AIIR best when it's under the surface and supporting human behaviour rather than fully sucking people to JM	Never mechanical parts CP	New tech CP	Monitoring with cameras and microphones for an easy connected home: JM			
Machine learning that complements the human, rather than replacing it	Interfaces fading into the background: MD	Swap parts before they need replacing - prescriptive maintenance BA	AR VR, there have been some great advancements, including with just audio: JM	3D printing - possible weight saving of 50% Airbus	Intelligent surfaces - haven't got caught on IW	Commodification of hardware: AM			
X Box inclusive design - allowing lots of different inputs and outputs - different modes of interaction	Only see screens when you need them CP	Need sensors to capture all sorts of different information - movement, mood, environment etc: FC	Infused canvas, rather than a fully immersive: JM	Collaborative vehicles which can be adapted into small factories to office: JM	Antennas on aircraft BA	Realtime hyper services in a limited connected environment: AM			
Make products that are usable for all consumers		IT tech such as AI: they were made and emotion recognition and big data analysis. These tech requires the addition of robots. Since robots have autonomy and ability to require surroundings they can be utilized outside of manufacturing industry such as service: AM	Real labors - VR fitness game: JM	3D printing changing the way that we build products: JS	Biological materials - changing shape based on humidity: Biological - Hydromorphic Biomaterials HE	IoT CP			
Interfaces need forces for consumers to react to	directional sound becoming more important with autonomous driving and the way that activities are changing side the car CP	Changing attitudes to sharing personal data MD	Drive get big data information in their glasses - your hardware work etc. and provide a more personalised experience: IW	Combine different layers of material: JS	"Material scientists are the alchemy of our time" HE	The standard experience is powerful (mobile and embedded): AM			
Connected interfaces with multiple inputs of data can be used more sophisticated eg can body position, body terms, facial expression to determine the user's mood	Why do you need a knob for AC? You set the temp and that's the temp you want CP	Changing attitudes to sharing personal data MD	Big AIIR display to show the things from the outside of the car that you can't see on the inside CP	How to combine Actuator, smart sensor, AI and those in display these tech become a new tech: JM	Bio tech is the most impressive HE	UX & UI to be reinvented to enable touch and tactile references in a digital world CP			
Get one part of the data will not make sense you need to look at it in context as possible	Exclusive personalised content everywhere else in life. This is becoming the expectation for cars CP	It's the software not the cameras that is developing: AM	Invisible: A pillar by projecting outside world onto inside of a pillar CP	Manufacturing different content provider when manufacturing different content providers and content providers: AM	Machine actuator tech - smaller, stronger: JMS				
VR has come a long way since most people think it is	Need to customise for functionality and need not physical accessories like speakers CP	Online security: If you could stream movies without being copied, or do banking: IW	Sensors under the car to show you what the ground is like eg Land Rover CP	Making different situations what manufacturing performance and reduce the cost and increase the performance: JMS	Material that is stronger, lighter and more durable: JMS				
There is no real progress in AR - people don't really know what to do with it yet: JS			Watch car capabilities - a car to follow CP						
	tailor a product and service matrix CP	Sensors IW							

Data interaction	Quality	Time	Easy connect/integrated	Cultural aspects	New mindset: Sustainability, human-friendly tech etc.	Organisational learning	Strategic alignment
IFE is more than just an entertainment device, it's digital signage: AM	Health/wellness moving more important MD	Faster gratification: MD	Lighting technology - mood lighting scenarios, make the food look better, and reduce jet lag. Not only colour: IW	Eye tracking CP	3D printing - possible weight saving of 50% IW	Changing attitudes to health data and privacy: AM	Don't confuse tech with value per good if it is intrinsic to the product with the core values of the brand
Cameras as health monitoring, or even sensing mood AM	Lighting technology - mood lighting scenarios, make the food look better, and reduce jet lag. Not only colour: IW	Time is people's main concern and the automotive industry is not looking at this CP	We need emotional connections & memories from smart products in cars. Not just tech. The car invites you to do things & makes suggestions: IW	Assess your own gut bacteria by using microchips inside pills to monitor the: JM	Materials from a sustainability point of view - light weight, and in-use of materials (and their perceptions): IW	There's a lot of fear around cameras, and it will go through its own cycle: JM	Everything has become a lot more things are going to be less casual
Services are becoming more important than hardware: MD	Clean space - ultra violet for water disinfection. Can now be applied to cabin disinfection. And Antimicrobial surfaces that kill bacteria - HEPA filters for clean air - exchanged every 2-3 minutes. Robots to clean air conditioning units automatically: IW	Demand for seamless on fast connectivity: IW	We've lost many things with Covid-19 and people want to reconnect with each other: IW	Brain scanning to track thoughts - biohacking to get you back to a better state: JM	Zero emission aircraft 2035 - flying v configuration: hydrogen engine: IW	Potential decoupling of China and US: MD	Embedded doesn't change that of technology vehicles: AM
Why is a car useful? Does Automotive need to move to new service business models to enable people to have the right kind of vehicle for the moment when they need it? CP	Not just health conscious, but mind conscious: JM	Free time from autonomous: IW	People are "scared of the invisible stuff" and so there is a need to make things tangible: IW	Meditation head set to monitor when you are in a meditative state: JM	Solutions that people can see are sustainable: IW	Army & Navy command and control is interesting: IW	technology on hardware is not as same cycle: AM
New generation of consumers not looking for a licence - the want control and the results: CP	Self optimisation - measuring heart rate etc.: FC	Meditative state while driving: JM	Time of voice and sense of tone are missing in interfaces - need to make better use of interpersonal communication: IW	deeper connection between the brain and devices - eg Elon Musk neurological remotes: JS	Energy waste from non-autonomous vehicles: IW	Cultural constraints and diversity: IW	product without a purpose is really being questioned: FC
tailor a product and service matrix CP	Understand trend due to COVID19: I expect robot will become useful in each time when people need to have physical communication with non-human entities. Customers will learn how to interact with non-human entities and robots are convenient devices and agents for that: JM		Perceive robots as agents not almighty human-like device: JMS	Bio hacking has given us a better awareness of ourselves: JM	Growth in sustainable energy: MD	Convenience economy to conscious economy is changing values and choices: JM	Story telling about the meaning of become more important than the in car: FC
Quicker life-cycles of products. Create infrastructure that allows you to upgrade: IW	need for home fitness - people working out collectively & on-line: JS	Micro moments to give you a different feeling of the tech, there is a diploia between them: JMS	When it comes to consumer traction, it is problem that robotic industry gets too much attention from consumers. The issue comes from the expectation beyond the realm of existing technology. The customer's expectations are higher than current: JMS		3D printing - weight reduction by using less material than traditional methods of manufacturing. Material only used where it is needed - more sustainable: CP	There is a growth in people's ambition for their own personal development and there are many tech tools to support this need: JM	The experience I have in the car is become the important thing: FC
Will people even own cars in the future? BA	tourism, healthcare and fitness: JS	Industries are starting new tech faster than before due to SWG service such as Youtube. It seems like there is no suppressing new tech: JM	The customers become smarter and wiser so that they can accept the technology as it is with its limitation: JMS		Green streamlining technology: JM	A car to encourage better driving: JM	Mobility not a car - a room to do things in: HE
We've lost many things with Covid-19 and people want to reconnect with each other: HE	Advice on how to be more healthy: JM	We time in the car: JM	Everything is Plastic so you can see and hear people and things but you don't know where the people are: HE		Devices that hold lots of functions also consume lots of power but the learning curve is too high: FC	React to what's around you by changing your driving style to give you data in exchange for a good value proposition: JM	Bio tech is a great metaphor and inspiration: HE
Smart homes are being owned by one brand: FC	We have seen the peak of health gadgets & self surveillance/monitoring is losing traction: JS	If the car is not connected, it forces me not to be connected. I force a calmness on me that I really rather enjoy: FC	There are new big problems like the lack of tangibility in telepresence but it helps us inspire and invent				Defying gravity: HE
Consumers are interested in experts/brands that can recommend the perfect combination of devices - this can save you time and get you better results: FC	too much pressure to keep up with living on line keeping up an image: JS	How do we perceive time in the car? FC					There is a move from convenience efficiency to greater planning and approach to life: JM

Appendix 11: Opportunities for ideation

Opportunities for Ideation							
nerThis is the (on the insight consumer)	Natural & easy interaction Companionship Seamless connection across different moments in your life	Better, more intuitive control that feels good	A more seamless transitions between different moments in your life Easier to use because you know the device	You become a better driver Lower insurance premiums A feeling accomplishment	A feeling of well-being in the car, a kind of comfort A more healthy environment to travel in	Augments and enhances your driving Changes your feelings to a Promotes safe driving	
actor			Embedded tech not compared against devices with faster life-cycles.				
Y Ideation							
not of an be used to generate							
Flexibility	Strategic alignment The current situation is that car interfaces are too complicated and are essentially transactional and the information is buried too deep. Because the user can't find what they need and because it's too complicated the features aren't used. If the interaction was more natural, better and more enjoyable user engagement would take place.	Collaborative Interfaces are very binary and with little nuance. Users and machines are missing out on a lot of stimulus and tactile qualities and information. If surfaces and objects have greater haptic qualities more subtle input and output can be achieved.	Organizational learning We have many different situations in our lives and our devices need to change to fit each situation and interact with other devices. Display or communicate information in a way that fits the situation and possibly at different scales.	Cultural aspects	Process adaptability	INFLUENCING LEARNING	
How to combine Autostar, smart sensor, AI and how to display these both become a new tech J1	Conversational interaction with an AI assistant, across different platforms Machine learning that compliments the human, rather than replacing it.	Interfaces need forces for consumers to react to Simulated feedback through the control to make flying different aircraft more familiar J4	Connectivity - seamless. Link all the elements. IoT onboard AI to track and adapt to patients progress - therapeutic control the aircraft, that allows for a really personalised experience J5 AI is in the car and AI assistant travelling across different platforms J2			Not just health conscious, but mind conscious. J2 Clean spaces - ultra violet for water disinfection. Can now be applied to cabin disinfection. And Antimicrobial surfaces that kill bacteria. HEPA filters for clean air - exchanged every 2-3 minutes. Robots to clean air conditioning units automatically. J4 Health wellness moving more important J2	More lighting scenarios, in J4 tag. Not only colour. J4 Deeper connection between Musk neurological remote
Robot feel is dangerous industry and most of the tech is already revealed. The main development of tech which has seen through public technology are IT tech, battery, motor and sensor J2	Allowing lots of different inputs and outputs - different modes of interaction	Better interfaces in vehicles are more than just a screen area. J4 *	Quicker life-cycles of products. Create infrastructure that allows you to upgrade. J4	There is a growth in people's ambition for their own personal development and there are many tech tools to support this need J4			
Demand for seamless on fast connectivity. J3	Invisible tech but a more digitized world J5	UX & UI to be reinvented to enable touch and tactile reference in a digitized world CP	technology on hardware is not accelerating at the same cycle J4				directional sound becomes driving and the way that we CP
	Simplify the car with tech DON'T complicate it with tech CP	People are "scared of the invisible stuff" and so there is a need to make things tangible J4	Passengers own device can be the continuum with the airlines relationship with the passenger J4 Embedded doesn't change that often - different technology solutions J4				
	We will be doing things in more unconsciously FC		When it comes to consumer traction, it is problem that robotic industry gets too much attention from consumers. The issue comes from the expectations beyond the realm of existing technology. The customer's expectations are higher than current tech, there is a disjoint between them J2D Changing view of car and the city, and finding different modes of transport, and how you purchase. J2D				
	Everything is Pixels so you can see and hear people and things but you don't know where the people are. I6 Infrared canvas, rather than a fully immersive. J4 Need to make communications and interactions feel more nature J5 Collaborative robots which can be adapted into smart factory to office J4		IoT CP				
	Diverse and affordable smart sensors J3P Unstuck trend due to COVID19. I expect robot will become useful in						

[illegible]