R&D MANAGEMENT

Disrupt through digital: a study on the challenges faced when digitalizing R&D

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Digitalization and automation represent potential sources of disruption to the organization and practice of research and development (R&D). Digitalization has the potential to revolutionize future R&D, as digitalized R&D may improve efficiency and minimize risk thus reducing cycle and development times. However, companies expect organizational challenges in their R&D organization when they start to implement and work with digital technologies. Through an in-depth case analysis, we investigate these organizational challenges at Unilever, one of the world's leading fast-moving consumer goods (FMCG) companies. Three challenges were identified: (1) managerial challenges; (2) behavioral challenges; and (3) digital technology skills challenges. Based on the identified challenges within the context of digitalizing an R&D center, our study provides some practical advice to R&D managers.

1. Introduction

Digitalization and automation represent potential sources of disruption to the organization and practice of R&D. Digitalization has the potential to have significant impacts on the efficiency and effectiveness of R&D (Naujok et al., 2016; Farrington and Alizadeh, 2017), as digitalized R&D will improve efficiency and minimize risk thus reducing cycle and development times. Chilukuri et al. (2017) highlight four key principles for companies to achieve a successful digital transformation in R&D: identifying the capabilities that lead to competitive differentiation, adopting digital technologies by integrating agile and data science into the organization, modernizing IT foundations by moving to digital platforms such as cloud servers, and building core management competencies that will enable a successful transformation.

Digitalization of R&D has been adopted most rapidly in the pharmaceutical, aerospace, and automotive industries. The chemical industry has been slower to adopt (Klei et al., 2017). Nonetheless, over the last decade, large companies in the formulation industries such as household and personal care, food, agrochemicals, coatings, and specialty chemicals have been slowly incorporating modeling and high-throughput experimentation into their R&D process.

Digitalization is not merely about installing digital technologies but involves organizational challenges related to workforce shape and skills, the organization of R&D, and the rate and character of adoption of these new technologies, processes, and practices (Blackburn et al., 2017; Farrington and

Alizadeh, 2017). Hence, companies should expect organizational challenges in their R&D organization when they start to implement and work with digital technologies.

There are a number of studies on the challenges faced by organizations when adopting digital technologies in different sectors. In the manufacturing sector, Simões et al. (2021) identified four challenges: interpersonal communication, competencies and skills, system integration, and technological strategies, while Abdallah et al. (2021) also identified skill gaps, the adoption of new technologies, change management processes, and policies and procedures. Konanahalli et al. (2022) studied the challenges that organizations in the facility management sector face when implementing digital technologies such as big data, and suggested that skills gap, data governance, and the management of human and financial resources are among the top challenges faced. Another sector that is witnessing rapid digitalization is the healthcare sector. Digitalization challenges in healthcare include data migration costs and skill gaps (Cresswell et al., 2022) and strategic change management and transformation of healthcare professions and practices (Petersson et al., 2022).

Reviewing the existing practitioner and academic literature has revealed that there are some differences in the challenges faced between sectors and even within the same sector in some studies. However, there is very little evidence demonstrating the challenges that organizations face with the adoption of digitalization, especially in the R&D function of a business. To address this gap, we ask the following research question: what challenges do organizations face when introducing digitalization of R&D?

We examine the research question through an in-depth case study investigating the role of a new digitalized R&D center at Unilever, one of the world's largest FMCG companies. This digitalized R&D center is the Materials Innovation Factory (MIF) based on the University of Liverpool (UK) campus, which was established in 2018 to promote digital transformation.

In this paper, we present the challenges that Unilever faced during the digital transformation of R&D, which included relocating some employees from Unilever's UK corporate R&D facility at Port Sunlight (Northwest England) to the MIF at Liverpool. We also provide theoretical contributions to the R&D management literature and practical implications for management.

Our study contributes to the literature in several ways. First, we expand previous research on challenges organizations face when going through a digital transformation by investigating the digitalization of R&D. Second, we identify a set of challenges faced when digitalizing R&D, categorized as managerial challenges, behavioral challenges, and digital technology skills challenges. Our study also provides several managerial contributions. Our identified challenges allow managers to understand how decisions made at a managerial level can contribute to the acceleration of digitalization adoption. Our findings also highlight the importance of specific managerial traits such as leadership and communication, as well as the importance of the role played by line managers during a digital transformation initiative.

The remainder of this paper is organized as follows. First, we present a brief review of the literature on digital transformation. Second, we explain the methodology that we followed, introducing our research context and the case study. Finally, we present our findings before discussing the results and presenting the contributions of the study, as well as future research direction.

2. Digitalizing R&D

Advanced analytics and big data, the internet of things, robotics, and artificial intelligence have advanced rapidly. Digital is applying these innovative technologies to reshape firms and society (Chilukuri et al., 2017). Digital disruption refers to how digital technologies are elevating industries and proposing new rules of business, while digital transformation refers to how organizations are adapting to the new situation that is created by digital disruption (Kane, 2019). Nambisan et al. (2017, p. 224) describe digital transformation as 'the creation of, and consequent change in, market offerings, business processes, or models that result from the use of digital technology'.

The digitalization of R&D comprises three main elements: automation and robotics, in-silico modeling, and big data analytics. The automation and robotics element includes physical robots working autonomously or in collaboration with humans on experimental procedures and testing, including high-throughput robotic labs that use data processing/control software; the in-silico element includes computer models providing predictive and explanatory tools to allow researchers to visualize and predict experimental procedures and testing to supplement experimental data or prioritize areas for experimentation; and the big data analytics element includes using advanced data analytics to generate insights from pools of structured and unstructured data (Farrington and Alizadeh, 2017).

Advocates expect that digitalization will improve the R&D process arguing that it will lead

to cheaper, better, and faster R&D (Euchner, 2017). Digitalization can reduce the cost of R&D by automating – and accelerating – some laboratory processes. Automation can handle routine tasks thus releasing skilled R&D staff to work on higher-value-adding activities. Using modeling reduces the need for costly and wasteful testing at pilot plants or on an industrial scale (Barbosa et al., 2020). Modeling will allow researchers to visualize and predict experimental processes, while automation will increase the accuracy of experimentation and testing by reducing the variability introduced by individual human practices and interpretation of standard operating procedures. Digitalization will improve overall time-to-market speeds for new products, while in-silico has the potential to speed up the rate of discovery by accelerating the experimental and testing process (Farrington and Alizadeh, 2017).

While the interest in digitalization is growing, there is little knowledge of the digitalization of R&D and the challenges and concerns that management faces through the digitalization process in general. The majority of current studies focus on the digitalization of the whole organization – not R&D specifically – across different sectors including healthcare (Gupta, 2018; Pohlmann et al., 2020), manufacturing (Zangiacomi et al., 2020), education (Chan and Zary, 2019), and pharmaceuticals (Schumacher et al., 2020). Very few studies investigate the challenges and concerns that rise with the opportunities presented by the digitalization of R&D. One of the concerns highlighted is among R&D employees about their fear of being replaced by robots. One of the digitalization trends highlights the increased usage of robots (Barbosa et al., 2020). Robots would enhance automation by relying on their flexibility, high performance, accuracy, large working volume (Yao, 2014), and the fact that they can finish tasks with minimal human interaction (Melanson, 2018). Big data analytics, machine learning, and artificial intelligence are key to digitalizing R&D. However, the human capital needed to deploy and use these technologies is different from what was previously known, as scientists would need a different set of skills. This could represent a challenge to organizations as new skills and competencies will be needed resulting in changes in both training and hiring activities, which raises the question about the willingness of organizations to invest in their human capital to support digitalization (Blackburn et al., 2017). The changes that digitalization of R&D will cause are not to be underestimated, where other than these specific challenges, one main question is about the readiness of R&D management to cope with these changes. To do so, R&D management should have a clear idea about the change management needed when digitalization is introduced to R&D functions (Cohen et al., 2016).

3. Methodology

Our research study adopts the case study methodology using a qualitative approach to help understand and explore the state-of-art context of the digital transformation of Unilever, and the major challenges that the company faced.

The case study methodology is considered a research strategy concerning how and why questions and allowing investigation of contextual realities and the differences between what was planned and what actually happened. It is also used as an empirical inquiry that investigates a contemporary phenomenon within a real-life context and probes an area of interest in depth which enables the researcher to understand the complex real-life activities. The case study approach enables researchers to go into the field, acting as an observer while collecting data for analysis and theory building.

3.1. Research context

3.1.1. Background

Unilever is one of the largest FMCG companies in the world employing 148,000 staff worldwide and its products are available in over 190 countries. Unilever products include food and beverages, home care, and personal care products and it owns brands including AX, Dove, WALL'S, Lipton, LUX, Persil, Knorr, Domestos, Hellmann's, Ben & Jerry's and Magnum. Innovation is considered a strategic priority within the firm (Unilever, 2022).

Unilever views automation and digitalization in R&D as a new way of doing business, with the vision to double the size of its business, while reducing its environmental footprint and increasing its positive social impact. The digitalization of R&D is a critical enabler in accelerating the innovation process around delivering superior, sustainable, and profitable products to market. The adoption of automation and digitalization across projects aims to enable product discovery, understanding, and innovation which would be difficult or impossible with conventional methods. The in-silico modeling, automation, and data analytics, as well as new operational processes and augmentation of workforce capabilities, are critical approaches and strategies to achieve better, faster, and cheaper R&D (Unilever, 2018).

3.1.2. Establishing the MIF

In 2014, a business plan was developed between the University of Liverpool and Unilever to establish the Materials Innovation Factory (MIF). The MIF became operational in 2017 and was officially opened in October 2018. The MIF is seen as the physical embodiment of the company's ambitions for the digitalization of R&D.

The MIF is a public-private research partnership with initial funding of £65 million from the University of Liverpool, Unilever, and the Higher Education Funding Council for England (HEFCE). It describes itself as the world's leading center for Computer Aided Materials Science, focusing on materials chemistry, soft solids, and complex mixtures, with a £37 million new build lab (11,000 m^2) over 4 floors with about £10 millions of scientific equipment, including a central analytical facility, 6 of the University of Liverpool's leading research groups, an open access area operating like a 'research hotel' open to any organizations/universities to work in. The MIF includes a dedicated floor occupied by Unilever that contains the largest concentration of robotics for Unilever worldwide.

With its significant investment in the MIF, Unilever views it not only as a lab with automated high-throughput equipment, but more strategically as a role model and catalyst to drive the broader agenda of digital transformation. The expectation is that it will lead to a fundamental change in the way that R&D is carried out within Unilever. The new ways of working at MIF are expected to be applied in other sites of Unilever globally and with partners to amplify value. Finally, MIF is seen as an incubator for scientists of the future developing the skills and mindset required for the future.

3.2. Data collection

In order to achieve the objectives of this study, the research used semi-structured interviews to collect primary data. The semi-structured interviews were conducted with a particular focus on MIF. Both managers and R&D scientists related to MIF were approached for interviews in order to collect information on the research context and understand the research question from various angles. A total of 30 face-to-face interviews were conducted (2017–2019) with a particular focus on Unilever's MIF facility. Table 1 provides a summary of interviews conducted for the scoping study.

All the interviews were conducted by at least two professionally trained researchers, using interview protocols that were designed especially for interviews with managers and scientists. Two different sets of questions were outlined (see Appendix A). For interviews with managers, the outlined questions include the understanding of digitalization, the main reasons beyond digitalization, the progress of digitalization, challenges, impacts, and expectations of digitalization, which aims to get the context to Unilever's digitalization and automation. For interviews with scientists, the outlined questions aim to understand their role as a scientist and how MIF affects their ways of working, their expectations and experience of working at MIF and how they were supported for using MIF facilities.

3.3. Data analysis

The data collected *via* semi-structured interviews was analyzed using a thematic analysis method (Braun and Clarke, 2006), which is a well-used method in qualitative research focusing on examining themes, identifying, analyzing, and reporting patterns based on interview data. This data analysis method was chosen because it does not rely on previously formualized categories from literature, but instead, generate the categories from within the data, which better serves the purpose of this study. The data were coded using the coding software Nvivo. Each interview was analyzed by at least two different researchers.

The first step for the researcher in a thematic analysis is to familiarize themselves with the data. This was done by reading through the data many times and the reading was done in two different ways: horizontally to read all the answers of one respondent to all questions, and vertically to read the answers to the same question by all respondents. After becoming familiar with the data, the second step of the thematic analysis was to generate initial codes. The strategy followed to do this was to go through the answers by question. The

Table 1. Summary of semi-structured interviews

Phase	Timeframe	Number of interviews (across categories)
First round interviews	Nov. 2017 to May 2018	5 managers 7 team leaders/scientists 6 scientists/technicians
Second round interviews	January 2019 to February 2019	3 managers 9 scientists/technicians

outcome of this step resulted in generating the first-order categories. The third step involved re-focusing the analysis at a boarder level and grouping the first-order categories. We repeatedly read the transcripts, coding and re-coding data, until we obtained the second-order themes. The last step involved defining and further refining the second-order themes to identify the aggregate dimensions. This was done through further reading and analysis of the data in order to group the second-order themes. This resulted in the identification of three aggregate dimensions as can be seen in Figure 1: managerial challenges, behavioral challenges, and digital technology skills challenges.

The first order categories represent informant-centric terms, while the second-order themes and aggregate dimensions represent a more researcher-centric understanding of concepts (Gioia et al., 2013). In this case study, the three aggregate dimensions reflect the challenges that Unilever faced during the digital transformation of their R&D center.

4. Findings

When the MIF was opened, some employees were relocated from Port Sunlight – one of Unilever's R&D centers in the United Kingdom – to the MIF. The MIF is different from the traditional ways of working at Port Sunlight in a number of ways. Automation in formulated products is new. The MIF is 100% digital where the robots automatically generate data and record it. The output data are transferred to a database and not into a lab notebook. The data is web enabled so data can be accessed anywhere within Unilever worldwide. Robotics allows reproducibility of the experiment and reduces variability and increases R&D

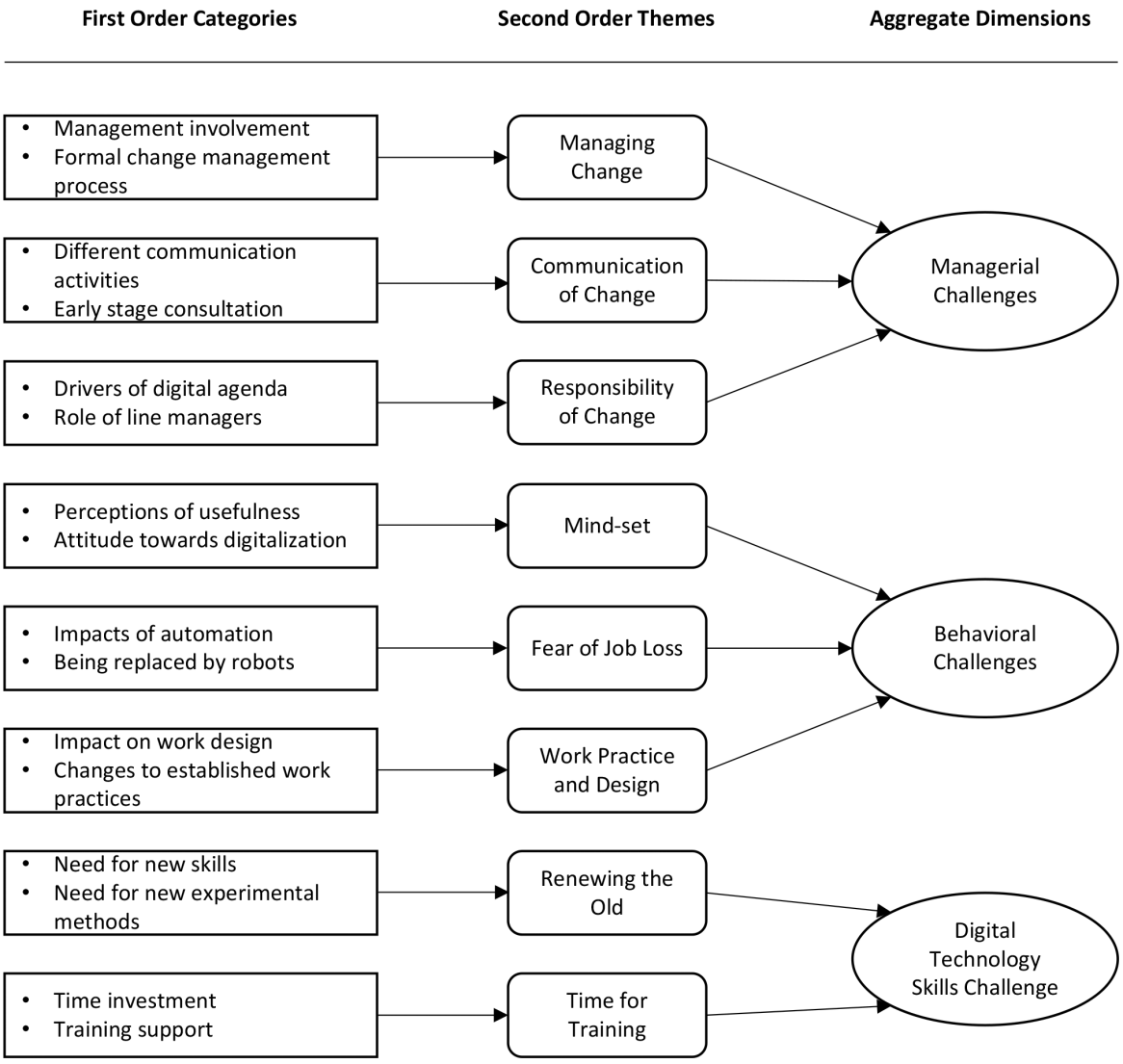

Figure 1. Data Structure.

productivity. These differences at the MIF compared to what employees were used to at Port Sunlight created challenges for both employees and management. One of the managers explained: 'The challenge is how they [staff] engage with equipment, use data, etc. It is very different to Port Sunlight'. Through our case study, we aimed to identify the main challenges that were faced. Below are the three main challenges that were identified: managerial challenges, behavioral challenges, and digital technology skills challenges.

4.1. Managerial challenges

4.1.1. Managing change

Digitalizing R&D is not an easy task. One of the main elements for a successful digital transformation is to acknowledge the change management needed and to have a plan in place to achieve that goal (Blackburn et al., 2017).

A number of managers and staff expressed the view that there was no formal change management process to move Unilever toward digitalization. This view was expressed in particular by early adopters and enthusiasts for the MIF who expressed their frustration at what they felt was a lack of urgency about the move toward digitalization. The following comment was typical of this view:

> 'A bottom up process involving a few enthusiasts. It does need something bigger above to support this… this needs a bigger initiative but [there is] not a formal change management [program] nor resource or finance behind it.' (03)

At the same time, other staff acknowledged the effort and the steps that the management is taking in order to ease the change process:

> 'There is also an effort to support staff in making these changes. Giving people the tools and helping them on the journey, allowing them to ask questions, not feel stupid when they don't understand.' (04)

> 'Some groups have very gentle KPIs [Key Performance Indicators] to encourage ways of working that are in-line with the digital strategy, emphasizing that this should be a job fundamental, the path to in-silico first as part of standardized way of working.' (05)

4.1.2. Communication of change

The senior managers responsible for the MIF reported that they had undertaken a variety of communication activities, including formal briefing sessions on the aims and objectives of the MIF and more informal 'drop-in' sessions to discuss individual concerns. There was an expectation that this would be 'cascaded' to staff by middle managers. The MIF's sponsors appear to have expected that staff would share their view of its value and that value would be automatically recognized and supported by staff and line managers. Nonetheless, a number of staff that we interviewed questioned the effectiveness of the communication of the vision for the MIF and the consequences for staff. One interviewee expressed the view that:

> '[The MIF's sponsors] didn't take the people with them. A surprise to them that people were very reluctant to come over. Assumed that people would be excited.' (07)

However, other employees expressed a different opinion, and explained that there was more communication about the MIF:

> 'I think there was a lot of formal communication on the MIF being ready and they were selling it as this new lab with new capabilities that were high throughput and it was going to revolutionize the way that we were doing some testing, which it definitely has.' (29)

Despite the communication activities undertaken by senior managers and the expectation of senior managers that this would be 'cascaded' by line managers, some staff said that they felt that there had been limited communication and consultation in the early stages of the MIF, while others said that they were consulted. Some staff reported that they remained unclear about the vision for the MIF. The following comments from interviewees reflect the feelings of some staff:

> 'I was told two years ago 'you're moving to the MIF'. There was little consultation. It was assumed by senior management that it was a good idea' (05).

> 'I think being part of a team that was going to have a workspace there we were involved right from the start, so for example I was on the site when it just started being built…I think being involved in it from that point of view was really useful and helped me especially buy into what they were trying to achieve with it.' (29)

4.1.3. Responsibility for change

A number of our interviewees confirmed it was unclear to them who had responsibility for driving the digital R&D agenda in the organization. A number of managers and staff saw the MIF Program Director as responsible for leading the change process. Other (senior) managers saw the need for responsibility to be diffused and decentralized across the organization. The MIF Program Director commented:

> 'I nominally have the roadmap, but I rely on others – [line] managers – my ability to influence change is limited… Line managers and program owners are the ones who make it happen. A classic matrix organization. The ownership of the change agenda doesn't sit with any one person – it is a collective management agenda.' (01)

Some senior managers recognized the importance of demonstrating their personal commitment to the MIF. One said to us:

> 'I'm there [MIF] on Friday this week; really from a leadership presence point of view, and to demonstrate to people…so I think director presence in the MIF is quite important.' (09)

There were also a number of comments about the important role of line managers. One member of staff observed:

> 'Managers have different styles and personal agendas. Project oriented managers pursue the changes to achieve project objectives. The people-oriented managers seek to avoid conflict in favor of retaining good relationships with their staff.' (03)

4.2. Behavioral challenges

4.2.1. Mindset

Working with the new digital technologies requires a change in the mindset of scientists. Interviewees explained that personality and mindset are very important to engage with digitalization. They explained that some people were willing to develop with the job while others were not. There were frequent mentions in our interviews about the role of 'mindset' as a factor in individual perceptions of the usefulness of the MIF to their work.

One scientist highlighted an individual perception as:

> 'I decided that it was going to be a good thing, the MIF, and I decided to just be unerringly positive about it and hope for the best, and when I got here [in the MIF] I liked it.' (23)

Others commented on mindset:

> 'It's the ones that have been doing the same thing for so long, don't like to change, even if they're forced into it.' (08)

> 'I think we saw some people that fully embraced it … I think there's been some people that are still very much stuck in their ways in terms of it and there's been more of a challenge in that sort of space.' (16)

4.2.2. Fear of job loss

Job security was something that employees were considering when thinking about digitalization. A number of managers commented on fear of job losses as a key factor.

> 'The fear is that digital changes way of working or leads to job loss. Machine does things better, more reliable, 24 hours a day. There is a fear factor that this may lead to job losses.' (02)

> 'I think people are scared that, particularly [of] the robots, that you don't need the person anymore, but they're very wrong, but they seem to think that, well if the robot's going to work, what am I supposed to be doing?' (03)

4.2.3. Changes to work practices and work design

The introduction of digitalization represents a significant and potentially disruptive change to established working practices, including employees' autonomy, job content, and interactions with other employees. Our interviews revealed different perceptions about the novelty of the MIF and the consequences for established routines and work practices. A formulation scientist who had worked for Unilever at Port Sunlight for two decades expressed the desire of many staff for predictability when stating:

> 'I suppose that's the thing. You don't want to do something new because you are so familiar with what you do and just go and do your job.' (14)

Digitalization at the MIF introduced auto data capture through the robots, which opened up the potential of capturing data and performing metadata analysis. This data is being saved on the cloud, and any employee (given the right authorization) can have access to that data. It seems much easier now for employees to search for data. Initially, data was stored at different locations, and as a result, lots of data was being lost. With the new digital technologies, all data are now stored in one place as one of the lead scientists explains:

> 'historically, data's stored in lots of places, people would store data on their own laptop or desktop and on the hard drives or instrument PCs. All the data in this building is all going into one common data management system.' (17)

4.3. Digital technology skills challenges

4.3.1. The need for new skills and experimental methods

Literature explains that digitalizing R&D will require a different human capital to deploy and

use these technologies as a different set of skills is needed (Blackburn et al., 2017). The need for changes to established work habits, training, and the development of new skills to effectively use the MIF's automated systems were also cited by some staff as making them feel that the MIF was difficult to use.

The traditional experimental work style of formulation scientists was characterized by an individualistic form of practice, requiring little in the way of collaboration. The *in-silico* modeling and high-throughput experimentation associated with the MIF require a significant change in working style and practices – it requires more planning, creates greater routinization, and places a much greater emphasis on data management and analysis.

One change to employees' work design was the need for scientists to plan their experiments ahead rather than on a day-to-day basis. They have to plan a 'campaign' of experiments rather than conduct a small number of experiments. There are new administrative processes required such as the need to book time on the robots. One of the scientists explained how the new work practice regarding planning experiments was a challenge that resulted in a better process:

> 'I think the biggest shift was how we planned experiments; I think [it] was the biggest challenge. But once you got into that obviously it just became a lot of…a better process for me and everyone else that was working there. I think again it was a big shift in a way of working.' (29)

The changes represent a challenge to the self-image and professional standing of some scientists, especially formulation scientists, who regard their work as a sort of craft that is not reducible to routinization and automation. As one engineer responsible for developing automated systems commented:

> 'When you get into it, they [formulation scientists] all do very different things, and there is that manual intervention that they never tell you about… So some people [formulation scientists] are just like, 'I'll leave it, I've got time to go and do some emails, come back and it'll be done then.' But you ask them how long? 'well it's just a while.' (09)

4.3.2. *The need for individual investment of time in training*

The need for staff to invest time in training and learning to effectively use the automated systems was also cited by some staff as making them feel that the MIF was challenging to use. Some interviewees explained that they had enough training to be ready to use the MIF:

> 'I think there is a Unilever induction, the university induction, I think there is a whole cascade of five trainings.' (22)

However, a number of managers and staff that we interviewed commented on the lack of time and incentives for training, expressing some frustrations with the initial use of the robots:

> 'To run a new test a member of staff needs to spend six months learning about the robots and developing new experiments.' (05)

> 'They have to learn how to use a robot, and sometimes the robots are quite frustrating, they don't always do what you want them to. And sometimes one error is enough to make someone just say, I'm never using that again.' (08)

> 'It's part of their work program and [if] they can see that the MIF is helping them to deliver their targets, then there is performance related pay associated with those targets. Now the counter to that is if they see that the MIF is going to slow them down because they've got to learn new stuff before…and then there will be a tension there.' (018)

5. Discussion

In this paper, we have investigated the digital transformation of R&D at Unilever, by looking at the MIF case study. For a digital transformation to be successful, it is crucial to understand what challenges organizations face in order to be able to overcome them.

Our study confirms the findings of previous research that investigated the adoption of digital technologies in other sectors, highlighting that, despite the expected benefits, digitalization in organizations requires a shift from previously established work and management norms (Sultan and van de Bunt-Kokhuis, 2012; Cresswell et al., 2022). As a result, digitalization should be viewed as a complex socio-technical transformation process, which requires mindset changes across the organization rather than just technological changes (Liu et al., 2021). The adoption of digital technologies is likely to impact the current working routines including managerial and day-to-day routines, creating new challenges for both management and employees.

This study contributes to the literature on R&D digitalization in several ways. First, it contributes to R&D literature by addressing the theoretical gap related to understanding digital transformation in the R&D function. Previous research has focused on the digitalization of the whole organization rather than

the digitalization of R&D and identified the relevant challenges for such a transformation (Gupta, 2018; Zangiacomi et al., 2020). However, the understanding of the challenges faced when digitalizing R&D remains under-explored. By examining the challenges organizations face when digitalizing R&D, our research complements previous studies that explored the organizational concerns with respect to R&D digitalization (Blackburn et al., 2017; Farrington and Alizadeh, 2017).

Second, our study identifies a set of several challenges that organizations face when digitalizing their R&D function. Our identified challenges can be categorized under three main categories: managerial challenges, behavioral challenges, and digital technology skills challenges. Our study extends existing research on challenges organizations face when adopting digital technology (Simões et al., 2021; Petersson et al., 2022) by focusing on the R&D function of an organization in the chemical industry sector. Previous studies looked into digitalization challenges in other sectors including manufacturing (Abdallah et al., 2021), healthcare (Cresswell et al., 2022), and facility management (Konanahalli et al., 2022).

Our study also offers several practical implications. The identified challenges within the context of digitalizing R&D can be used as a basis to formulate some advice for R&D managers. Our contributions provide insights to R&D management, calling on managers to make decisions based on the potential challenges the organization will face when going through digitalization.

First, the challenges we identified allow managers to consider how actions taken at organizational, individual, and technological levels can contribute (or not) to the acceleration of the adoption of digitalization. By connecting actions to perceptions and consequences, we provide a path that managers can follow in a digital transformation. R&D management should have a defined strategy on how to get their employees on board *via* a clear approach to digital skills trainings that should focus on updating and developing existing training systems to incorporate these new skills.

Second, our findings show that there is a need for clear and ongoing management of change all the way through a digital transformation process. R&D management must have a clear communication strategy that considers keeping employees aware of the upcoming changes at the early stages of the project and throughout the whole lifecycle of the digital transformation. Information about the digital transformation should be shared internally by running different events and campaigns, posting detailed information on the intranet site, and developing knowledge guides. Line managers should recognize that maintaining high levels of communication and collaboration within their teams is crucial to the success of digital transformation. To be able to overcome the resistance to change challenge, R&D managers need to work closely with the R&D scientists and engineers in order to address their fears and concerns regarding topics such as potential job losses and new work practices. This collaboration should result in a shift toward a more positive mindset which should help to overcome any resistance to change.

Finally, our findings highlight the importance of supporting employees in developing the know-how and skills to be able to use the newly implemented digital technologies. The digital technology skills challenge is present in R&D digitalization as in other organizational divisions and sectors (Abdallah et al., 2021; Petersson et al., 2022). Managers should facilitate training delivery and allow employees enough time to learn and develop knowledge guides (von Krogh et al., 2000). R&D employees should be provided with time and incentives for training, as they will need to learn new skills in order to be able to adopt the new digital technologies. A key managerial implication of our findings is also rooted in making company corporate management teams aware of the importance of employee-management relationships. More specifically, the quality of communications, training, and support to ensure successful digitalization in R&D.

Our research has some limitations. We collected data through one case study in one sector (FMCG). As a result, our findings are not generalizable. Future research can study the challenges faced by organizations digitalizing R&D functions in different sectors. Our research followed a qualitative approach using interviews to collect data. Future research can consider a different methodology to validate our results. For example, researchers can build on our identified challenges, and test these challenges as variables to study their impact on digital technology adoption through a quantitative study that would collect data through a survey. Although we did our interviews over two rounds, we did not interview the same people. Future research can include longitudinal studies that interview the same people with a period gap in order to understand if challenges change as time passes and employees get used to digital technology.

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Data availability statement

Data are available from the authors with the permission of Unilever.

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APPENDIX A

INTERVIEW QUESTIONS

Managerial Questions (questions to managers to understand context to Unilever digitalization/automation):

1. The term ‘digitalization’ is widely used today, both within Unilever and elsewhere. What does digitalization mean to you? How do your colleagues interpret the term? Does their interpretation differ significantly from yours? If so, in what way?
2. In your opinion, what are the main reasons Unilever is introducing digitalization?
3. How far have you progressed with digitalization?
4. What have been the challenges? What have been the challenges for others do you think?
5. Have the working practices of staff changed as a result of digitalization?
6. How do you see the introduction of digitalization in the near to medium future?

Questions for Scientists (questions directed at scientists whose roles include working in the MIF):

1. What were your expectations of MIF before you began working here?
2. What training have you received for MIF?
3. What does MIF mean for the way that you work?
4. How long did it take you to feel mastery of the work process? (What scales of self efficacy?)
5. What are the main challenges that you’ve faced?
6. How has your experience compared to that of your colleagues?
7. More widely, do you have any views about the introduction of digitalization in Unilever?