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Surviving Industry Convergence: Ambidexterity via Internal Development, Alliances and Acquisitions

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Industry convergence (IC), the blurring of boundaries between previously separate industries, is a pervasive phenomenon. The emergence of new products, resources and competitors as a result of IC poses a threat to firm survival. Importantly, IC differs from other contexts of technological change that bear their origin in an emerging technology that may substitute or make obsolete an existing technology. Yet, little is known about how firms may survive IC. We theorize that the degrees to which firms explore or exploit using their growth modes (i.e. internal development, alliances and acquisitions) by emphasizing an ambidextrous posture may affect their likelihood of survival. We hypothesize that a high degree of exploration in internal development and alliances and a high degree of exploitation in acquisitions positively affect the likelihood of firm survival. Our hypotheses received strong support in a sample of 231 firms from a period of IC between the telecommunication equipment and data networking industries between 1989 and 2003. Our study opens a new research frontier on IC by proposing a novel theoretical approach based on examining the ambidexterity within and across growth modes to better understand firm outcomes during IC. It also contributes to research on growth modes.

Introduction

Industry convergence (IC) is the blurring of boundaries between previously separate industries (Diamandis and Kotler, 2020; Greenstein and Khanna, 1997; Sick and Bröring, 2022). IC is a pervasive phenomenon that has affected nearly 50% of industries constituting the Standard & Poor 500 index (Hsu and Prescott, 2017; Kim *et al.*, 2015). What makes IC novel relative to other contexts of technological change is that it involves the blurring of previously separate industry boundaries. In contrast, other contexts of technological change arise when an emerging new technology gradually substitutes or makes obsolete an existing legacy technology, thus threatening the survival of firms possessing the legacy technology due to the eventual elimination of their industry (Ansari and Krop, 2012; Christensen *et al.*, 2018; Eggers and Park, 2018). However, what differentiates IC from other contexts of technological change is that during IC, both industries continue to exist even though one may be more dominant in terms of generating customer demand and revenue (Greenstein and Khanna, 1997; Hsu and Prescott, 2017; Malhotra and Gupta, 2001).

Importantly, IC results in the emergence of new resources and competitors, changing customer demand and a race to introduce new products to address such demand (Benner and Tripsas, 2012; Chaturvedi and Prescott, 2020; Lee, 2007). Owing to this, IC results in a novel, complex and fast-changing competitive context for firms in converging industries wherein demand for their existing products declines, thus threatening their survival (Han, Chung and Sohn, 2009; Huang *et al.*, 2015; Uzunca, 2018). To increase their likelihood of survival, firms need to develop or gain access to new resources and enter product markets that emerge because of IC (or converging markets) (Benner and Tripsas, 2012; Chaturvedi and Prescott, 2020, 2022).

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However, as IC differs from other contexts of technological change, prior research that examined how firms survive these contexts of technological change (Christensen *et al.*, 2018; Eggers and Park, 2018) may not necessarily be relevant for firms that need to survive IC. This indicates a need for new theoretical insights (Kim *et al.*, 2015; Sick and Bröring, 2022). While prior research on IC has hinted at the importance of growth modes for improving firm performance (Benner and Tripsas, 2012; Hsu and Prescott, 2017), little is known about *how* firms employ growth modes to survive IC. We propose that examining how firms employ growth modes to survive IC is an important line of enquiry – particularly given the preponderance of IC across several industries and the implications it posits for firm longevity. Thus, we ask: During IC, how do firms use growth modes to improve their likelihood of survival?

We propose that to improve their likelihood of survival during IC, firms must develop or gain access to new resources and enter converging markets by employing multiple growth modes such as internal development, alliances and acquisitions (Capron and Mitchell, 2009, 2012; Stettner and Lavie, 2014). We theorize that the attributes of growth modes – such as the *degree* to which they are employed for exploration or exploitation – affect the likelihood of firm survival. Drawing on the ambidexterity perspective of the exploration/exploitation lens (Gupta, Smith and Shalley, 2006; March, 1991; O'Reilly and Tushman, 2013; Tushman and O'Reilly, 1996), we define the degree of exploration or exploitation as 'the relative emphasis on exploratory or exploitative activities in a growth mode'. When firms employ a greater number of exploratory activities relative to exploitative activities in a single growth mode, they place a higher emphasis on exploration relative to exploitation in that growth mode and vice versa, thus demonstrating ambidexterity *within* that growth mode (Greve, 2007; Lavie, Kang and Rosenkopf, 2011; Phene, Tallman and Almeida, 2012). However, when firms employ multiple growth modes, they place a higher emphasis on exploration relative to exploitation in some growth modes and vice versa in other growth modes, thus demonstrating ambidexterity *across* growth modes (Chaturvedi, 2023; Stettner and Lavie, 2014).

Subsequently, we theorize that to survive IC, firms need to be ambidextrous in their deployment of growth modes (i.e. they must explore and exploit to different degrees within and across growth modes). We posit that a high degree of exploration in internal development and alliances is more likely to develop and access new resources and enter converging markets to adapt and survive IC, in contrast to the inertial tendencies inherent to a high degree of exploitation in both growth modes (Greve, 2007; He and Wong, 2004; Stettner and Lavie, 2014). Alternatively, a high degree of exploitation in acquisitions is more likely to provide scale-related and positional advantages (e.g. higher revenue from new products and market share) and increase firms' operational efficiency in converging markets, thus increasing the likelihood of survival (Moeen and Agarwal, 2017; Moeen and Mitchell, 2020; Seth, 1990). In contrast, a high degree of exploration in acquisitions leads to firms acquiring unfamiliar targets with long turnaround times and leads to uncertainty in developing new products (Puranam, Singh and Zollo, 2006; Schweizer, 2005).

We tested our hypotheses using a dataset of 231 firms and 3125 growth-mode activities related to a period of convergence between the telecommunication equipment (hereafter, equipment) and computer networking (hereafter, networking) industries between 1989 and 2003. The emergence of packet switching (data-based) technologies in networking product markets led to their convergence with equipment product markets based on circuit switching (voice-based) technologies, because voice and data functionalities could be combined into a single 'integrated' product (Bhise *et al.*, 1999; Seaberg *et al.*, 1997). As integrated products became popular and their demand increased, they posed a threat to firms with products that provided only voice- or data-based functionality by depressing demand for them. In response, firms used growth modes to develop or gain access to integrated products or enter the integrated products market to adapt and increase their likelihood of survival. We found strong support for our hypotheses that was robust to several checks.

Our study contributes to research on IC. First, notwithstanding that IC is a novel form of technological change that differs from alternative contexts, prior research has rarely examined how firms employ growth modes to survive IC. We find that firms which demonstrate ambidexterity by appropriately emphasizing exploration and exploitation within and across multiple growth modes are more likely to survive IC. Our results depart from the findings related to other contexts of technological change that show a high degree of exploration, being more conducive to firm survival in comparison to a high degree of exploitation that has found limited support as a survival mechanism. In contrast, our study demonstrates the importance of ambidexterity within individual growth modes as well as across multiple growth modes as a survival mechanism during a context of IC. Thus, we advance a new research frontier related to IC by demonstrating how ambidexterity within and across multiple growth modes is one strategy for firms to survive IC.

Our study also contributes to research on growth modes which has found that firms address their resource gaps by *concurrently* employing multiple resource-accessing modes (Capron and Mitchell, 2009; Stettner and Lavie, 2014). We extend this body of work to the context of IC. Our findings show that the concurrent employment of three growth modes (internal

development, alliances and acquisitions) enabled firms to demonstrate ambidexterity by appropriately emphasizing exploration and exploitation within and across the three growth modes to survive IC. Thus, we show that developing theoretical insights on the concurrent use of multiple growth modes can improve our understanding of how this affects firm outcomes and how it drives firm heterogeneity.

Theory and hypotheses

Industry convergence

Industry convergence is defined as the 'blurring of boundaries between previously different industries' (Diamandis and Kotler, 2020; Greenstein and Khanna, 1997; Kim *et al.*, 2015; Sick and Bröring, 2022). Recently, IC has become a pervasive phenomenon across several industries, such as the digital distribution of music (Benner and Waldfogel, 2016), digital photography (Benner and Tripsas, 2012), banking (Pietronudo, Del Gaudio and Leone, 2021), energy (Park and Heo, 2020) and gambling/gaming (Derevensky and Griffiths, 2019). Prior research has found IC to be a novel phenomenon where the boundaries of previously distinct industries begin to blur due to one or multiple antecedents, such as demand-side changes – customers demanding new product features or functionalities (Benner and Ranganathan, 2013; Benner and Tripsas, 2012; Han, Chung and Sohn, 2009), changes to government policy (Chan-Olmsted, 1998; Hendershott, Lee and Tompkins, 2002), firm diversification (Malhotra and Gupta, 2001) and changes to technology (Greenstein and Khanna, 1997; Uzunca, 2018).

In contrast, other contexts of technological change arise when an emerging new technology gradually substitutes or makes obsolete an existing legacy technology, thus threatening the survival of firms due to the eventual elimination of the industry underpinned by the legacy technology (Ansari and Krop, 2012; Christensen *et al.*, 2018; Eggers and Park, 2018). However, what differentiates IC from other contexts of technological change is that during IC, both industries continue to exist even though one may be more dominant in terms of generating customer demand and revenue (Greenstein and Khanna, 1997; Hsu and Prescott, 2017; Malhotra and Gupta, 2001). In addition, while other contexts of technological change primarily owe their origin to a new technology, IC is a unique context as it involves the blurring of industry boundaries, for which changes to technology are but one of several possible antecedents.

Prior research on IC has found that it unfolds via two processes: demand-side and supply-side convergence (Bröring, Martin Cloutier and Leker, 2006; Greenstein and Khanna, 1997; Malhotra and Gupta, 2001; Stieglitz, 2003). Demand-side convergence occurs when customers perceive the products of two previously separate industries to have substitution linkages and/or complementary linkages (Greenstein and Khanna, 1997; Malhotra and Gupta, 2001). Substitution linkages arise when the products of two industries develop similar features or functionalities, thus making the two sets of products interchangeable for customers (Hsu and Prescott, 2017; Lee, 2007). In this context, the threat of substitution posed by firms in one industry to those in the other industry triggers survival-threatening consequences for both (Sick and Bröring, 2022; Uzunca, 2018).

Alternatively, complementary linkages arise when the products of two industries possess features or functionalities that become mutually reinforcing to each other or to those of a third industry, that is, the features lead to greater customer utility when used together, thereby encouraging customers to patronize products that 'bundle' the features, thus facilitating one-stop shopping (Benner and Tripsas, 2012; Chaturvedi and Prescott, 2020; Greenstein and Khanna, 1997). As customers increasingly prefer to use the various product features simultaneously and rivals offer products with complementary features, firms that provide products with only the individual features face a decline in product demand and a threat to survival (Arruda Filho and Brito, 2017; Han, Chung and Sohn, 2009; Lee, Lee and Garrett, 2013).

Finally, supply-side convergence arises when firms belonging to two industries perceive that their products are linked (Bröring, Martin Cloutier and Leker, 2006; Malhotra and Gupta, 2001; Stieglitz, 2003). Thus, firms in one industry begin to manufacture and sell the products of the other industry in addition to products from their own industry and vice versa, thus providing customers with the choice to use the products on a standalone basis or as a bundle (Bröring, Martin Cloutier and Leker, 2006; Stieglitz, 2003). Consequently, this leads to a threat to the survival of firms that provide only the product corresponding to their parent industry (Han, Chung and Sohn, 2009; Huang *et al.*, 2015).

The above-mentioned variants of IC lead to the emergence of new resources, competitors and products that result in a novel, complex and fast-changing context for firms. In turn, these dynamics lead to a decrease in demand for firms' existing products and a decline in their existing markets, thus threatening their survival (Han, Chung and Sohn, 2009; Huang *et al.*, 2015; Uzunca, 2018). To increase their likelihood of survival, firms need to develop or access new resources linked to IC and enter converging markets (Hsu and Prescott, 2017; Lee, 2007). Building on the demand- and supply-side perspectives of IC, we next discuss how firms can employ growth modes for exploration and exploitation to develop or access new resources and enter converging markets to overcome the threat of survival posed by IC.

Growth modes, exploration and exploitation

Prior research defines growth modes as vehicles that enable firms to access new resources and capabilities to gain competitive advantage (e.g. internal modes such as internal development and external modes such as alliances and acquisitions) (Capron and Mitchell, 2009, 2012; Stettner and Lavie, 2014). We theorize that via their capacity as growth modes, internal development, alliances and acquisitions increase the likelihood of firm survival during IC. We employ the ambidexterity perspective of exploration and exploitation (Gupta, Smith and Shalley, 2006; March, 1991; O'Reilly and Tushman, 2013; Tushman and O'Reilly, 1996) to theorize that exploration and exploitation represent attributes that characterize growth modes. Adapting March's (1991) definitions of exploration and exploitation, we define exploration as 'searching for or experimenting with new resources linked to IC and entering converging product markets' and exploitation as 'improving or refining the efficiency of resources and ongoing initiatives in converging product markets'.

We define the degree of exploration or exploitation in a growth mode as the 'relative emphasis on exploratory or exploitative activities within a growth mode'. Growth modes vary in their *degree* of exploration or exploitation. At any time, firms employ both exploratory and exploitative activities within a growth mode, but they emphasize one over the other, thus demonstrating ambidexterity *within* that growth mode (Greve, 2007; Lavie, Kang and Rosenkopf, 2011; Phene, Tallman and Almeida, 2012). When firms use multiple growth modes, they place a higher emphasis on exploration relative to exploitation within some growth modes and vice versa within other growth modes, thus demonstrating ambidexterity *across* growth modes (Chaturvedi, 2023; Stettner and Lavie, 2014).

As per the above, we theorize that to survive IC, firms need to be ambidextrous in their deployment of growth modes. Exploration using growth modes enables firms to develop new resources linked to IC and enter converging markets to engage in the process of supply-side convergence, independently or using alliances and acquisitions (Danneels and Sethi, 2011; Lee, 2007; Stettner and Lavie, 2014). Thus, firms may increase their ability to adapt to IC. Exploitation augments the scale and operational efficiency of resources and ongoing product-level initiatives in converging markets (Salomon and Martin, 2008; Seth, 1990; Singh and Mitchell, 2005). By doing so, exploitation enables firms to develop size-related and positional advantages such as revenue growth and market leadership that increase their ability to adapt to IC (He and Wong, 2004; Hoskins and Carson, 2022; Salomon and Martin, 2008). Firms may do so by either growing within their industries or engaging in supply-side (convergent) diversification. Below, we link the demand- and supply-side perspectives of IC and the ambidexterity perspective on growth modes to develop our hypotheses (see Figure 1).

Degree of exploration hypothesis – internal development growth mode

Ambidexterity within internal development contributes to performance in contrasting ways, depending on whether firms emphasize a high degree of exploration over exploitation or vice versa (Greve, 2007; He and Wong, 2004; Xie and O'Neill, 2014). A high degree of exploitation in internal development enables firms to employ their existing resources to improve performance in existing markets (He and Wong, 2004; Hoskins and Carson, 2022; Salomon and Martin, 2008). However, to survive IC, firms must develop new resources linked to IC and enter converging markets to engage in the process of convergent (supply-side) diversification – an imperative more effectively addressed by emphasizing a high degree of exploration (Danneels and Sethi, 2011; Greve, 2007; He and Wong, 2004).

Unlike other contexts of technological change where the internal technology resources of firms are substituted or rendered obsolete by new technology resources (Christensen *et al.*, 2018; Eggers and Park, 2018; Mitchell, 1992), IC involves the blurring of industry boundaries. Thus, during IC, a firm's internal resources may not be substituted or rendered obsolete but may instead contribute to developing new products that leverage the complementarity between different features or functionalities (i.e. from complementary linkages) or to cannibalizing existing products prone to declining demand (i.e. from substitution linkages) (Benner and Tripsas, 2012; Danneels and Sethi, 2011; Mitchell, 1992). Thus, we predict that firms emphasizing a high degree of exploration in internal development have a greater likelihood of surviving IC.

We employed Ansoff's Strategic Opportunity Matrix to develop the theoretical arguments for our prediction (Ansoff, 1965, 1977) (see Appendix A for details). As per Ansoff's matrix, new product development entails one approach to exploration that addresses customer demand in converging markets (Benner and Tripsas, 2012; Danneels and Sethi, 2011; Voss and Voss, 2013). New product development equips firms to remain abreast of the latest market developments, align product offerings more effectively with evolving customer demand and hence adapt to the fast-changing nature of the IC environment (Danneels and Sethi, 2011; He and Wong, 2004; Mitchell, 1992).

A second approach to exploration as per Ansoff's matrix refers to market development (Ansoff, 1965, 1977). This approach entails firms reconfiguring their product portfolios by adding new product lines with novel features to address evolving demand in

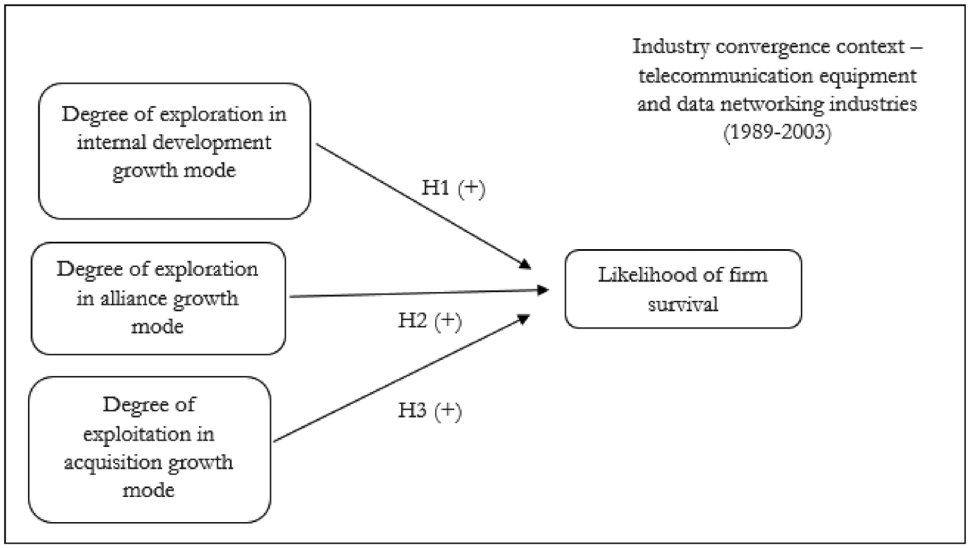

Figure 1. Theoretical model

converging markets. Broader product portfolios enable firms to address customer demand via entry into smaller niches in converging markets (Dowell, 2006; Klingebiel and Joseph, 2016). Doing so enables firms to achieve greater market share in converging markets by addressing demand linked to multiple customer segments (Cottrell and Nault, 2004; Giarratana and Fosfuri, 2007). Concomitantly, firms may cannibalize (or eliminate) existing products that face declining demand or are susceptible to the demand-side substitution linked to IC (Chandrasekaran, Tellis and James, 2022; Danneels and Sethi, 2011).

Exploration in internal development also leads to diversification, a third alternative in Ansoff's matrix wherein firms combine a new product strategy with a new market entry strategy during IC (Ansoff, 1965; Benner and Tripsas, 2012; Xie and O'Neill, 2014). Diversification enables firms to establish an early presence in converging markets that may transition quickly from a growth phase to a 'takeoff' phase as customer demand increases due to complementary linkages (Agarwal and Bayus, 2002; Golder and Tellis, 2004). The 'takeoff' phase represents a potential opportunity for firms to increase revenue and market share and develop a dominant position in converging markets (Shen and Villas-Boas, 2010). Thus, diversification positions firms to respond to demand- and supply-side convergence by equipping them to pre-empt rivals in the ongoing competitive race.

Finally, firms may explore the possibility of integrating multiple product lines as part of a single offering via inter-product complementarity, that is, addressing complementary linkages (Vinokurova, 2019; Ye, Priem and Alshwer, 2012). This enables firms to address several aspects of customer demand via cross-selling and bundling of several product lines, resulting in demand-side synergies that increase revenue and market share (Cabral and Natividad, 2016; Ye, Priem and Alshwer, 2012).

Thus, we theorize that firms which emphasize a high degree of exploration in the internal development growth mode are more likely to develop new products and enter converging markets that increase their ability to adapt to IC. We predict that such firms may have a higher likelihood of survival.

H1: During a period of IC, emphasizing a high degree of exploration relative to exploitation in the internal development growth mode will positively affect the likelihood of firm survival.

Degree of exploration hypothesis – alliance growth mode

Ambidexterity within the alliance growth mode contributes to performance in contrasting ways depending on whether firms emphasize a high degree of exploration over exploitation or vice versa (Lavie, Kang and Rosenkopf, 2011; Rothaermel and Deeds, 2004; Wassmer, Li and Madhok, 2017). Unlike other contexts of technological change where alliances enable firms to access new technologies and overcome the inertia and rigidity imposed by an existing technology (Chaturvedi and Prescott, 2022; Mitchell, 1992), the motivation behind exploration via alliances may be different during IC. For instance, alliances provide access to new product features and functionalities emerging due to products becoming complementary during IC, thus leveraging complementary linkages across industries – an outcome topical to IC contexts (Chaturvedi and

Prescott, 2020; Frankort, 2016). We predict that firms emphasizing a high degree of exploration in alliances may have a higher likelihood of survival.

One way by which exploration via alliances enables firms to survive IC is by providing access to technological and new product development resources (i.e. 'soft' resources) that facilitate entry into converging markets (Dyer, Kale and Singh, 2004; Frankort, 2016; Mitchell, 1992). For instance, new product development alliances facilitate learning via joint problem-solving, fine-grained information-sharing and leveraging complementarity between product lines of alliance partners, thus facilitating the prospect of product bundling during IC (Lavie, Kang and Rosenkopf, 2011; Rindova *et al.*, 2012; Rothaermel and Deeds, 2004). These alliances also lead to the development of new or complementary products that address novel aspects of customer demand and raise willingness to pay (Chaturvedi and Prescott, 2020; Rothaermel and Deeds, 2004). In parallel, alliances that explore emerging technologies enhance a firm's competitive positioning in converging markets that may develop a high growth potential in future (Maula, Keil and Zahra, 2013; Rindova *et al.*, 2012). For instance, cross-licensing where partners employ each other's technological patents to develop complementary products enables entry in converging markets (Teece, 2018).

Exploratory alliances also equip firms to develop flexible, short-term investments (growth options) in converging markets that address two imperatives. First, such investments facilitate firms to cope with demand-side convergence-related uncertainty resulting from rivals' competitive decisions that underpin the complex and fast-changing environment of IC (Dyer, Kale and Singh, 2004; Rindova *et al.*, 2012; Tong and Li, 2011). Second, these investments enable firms to effectively leapfrog rivals in the competitive race arising as an outcome of supply-side convergence (Capron and Mitchell, 2009; Lee, 2007). Growth options constitute an opportunity pipeline that provides flexibility whereby firms may increase or decrease resource commitment to an 'option' contingent on its utility towards new product development or entry into converging markets (Ceccagnoli, Higgins and Kang, 2018; Maula, Keil and Zahra, 2013). Thus, growth options may serve an important role in firms' attempts to adapt to IC as they enable them to establish early foothold positions in converging markets.

Importantly, the above benefits of exploratory alliances are likely to outweigh concomitant risks as such alliances may not require significant and irreversible resource commitment. Additionally, they provide firms with the alternative to incrementally increase or decrease additional commitments, contingent on whether intermediate outcomes may materialize (Ceccagnoli, Higgins and Kang, 2018; Tong and Li, 2011).

In contrast, a high relative emphasis on exploitation in alliances enables firms to access complementary resources such as distribution channels, marketing, sales and service resources for greater penetration in existing markets (Colombo, Grilli and Piva, 2006; Lavie, Kang and Rosenkopf, 2011; Singh and Mitchell, 2005) and access process technologies for greater operational efficiency (Wassmer, Li and Madhok, 2017). Thus, a high degree of exploitation in alliances may not effectively address the need to gain access to new products and enter converging markets – outcomes central to surviving IC (Lee, 2007).

Thus, firms that emphasize a high degree of exploration in the alliance growth mode are more likely to access new products and enter converging markets to adapt to IC. We predict that such firms may have a higher likelihood of survival.

H2: During a period of IC, emphasizing a high degree of exploration relative to exploitation in the alliance growth mode will positively affect the likelihood of firm survival.

Degree of exploitation hypothesis – acquisition growth mode

Ambidexterity within the acquisition growth mode affects firm performance in contrasting ways depending on whether firms emphasize a high degree of exploration (i.e. diversifying acquisitions) over exploitation (i.e. within-industry acquisitions) or vice versa (Choi and McNamara, 2018; Phene, Tallman and Almeida, 2012; Puranam, Singh and Zollo, 2006). While acquisitions enable firms to explore the new technology and overcome the inertia and rigidity imposed by an existing technology in most technological change contexts (Chaturvedi and Prescott, 2022; Titus, House and Covin, 2017), during IC, acquisitions are more suitable for exploitation when the uncertainty related to IC decreases (Dyer, Kale and Singh, 2004; Hsu and Prescott, 2017).

Exploitative acquisitions are within-industry acquisitions that enable firms to more substantially employ the technologies and product features and functionalities and leverage the substitutive and complementarity linkages resulting from IC due to the post-acquisition integration of exploitative acquisitions being less challenging (Chan-Olmsted, 1998; Chatterjee, 2009; Puranam, Singh and Zollo, 2006). Thus, we predict that when firms place a higher relative emphasis on exploitation in acquisitions, they will have a higher likelihood of surviving IC.

One alternative by which exploitation via within-industry acquisitions enables firms to survive IC is due to size-related and positional advantages, that is, greater revenue growth from products linked to IC and greater

penetration in converging markets that increases market share and hence enables firms to effectively compete with new rivals that emerge due to IC (Moeen and Agarwal, 2017; Moeen and Mitchell, 2020). Additionally, exploitation via within-industry acquisitions provides fast and exclusive access to complementary resources – for example, 'hard resources' such as manufacturing capacity and distribution channels (Dyer, Kale and Singh, 2004; Mitchell, 1992; Moeen and Mitchell, 2020) – and functional resources (King, Slotegraaf and Kesner, 2008), reducing dependence on ecosystem actors (Shahrur, 2005) and enhancing market dominance over rivals (Motta and Peitz, 2021). In addition, exploitative acquisitions also lead to greater product quality, thus augmenting reputation and leading to greater repeat business (Dranove and Shanley, 1995).

Two other benefits of exploitative within-industry acquisitions during IC arise from serial acquisition strategies (Bhussar *et al.*, 2022; Laamanen and Keil, 2008) and consolidation (Anand and Singh, 1997; Wood, 2009). Serial acquisitions facilitate fast entry and expansion due to economies of time compression, as post-acquisition integration challenges are alleviated due to greater familiarity with the IC context (Bhussar *et al.*, 2022; Chatterjee, 2009; Vermeulen and Barkema, 2002). Additionally, the benefits of familiarity in post-acquisition integration enable firms to pursue a consolidation strategy in declining markets, that is, firms increase operational scale and efficiency by taking over inefficient rivals and eliminating overcapacity to redeploy released resources in converging markets (Anand, 2004; Anand and Singh, 1997; Wood, 2009).

In contrast, a high relative emphasis on exploration in acquisitions involves purchasing new resources linked to new markets by making diversifying acquisitions (Chaturvedi and Prescott, 2022), acquiring start-ups (Andersson and Xiao, 2016; Brueller and Capron, 2021) or establishing foothold positions in nascent markets (Benson and Ziedonis, 2009; Tong and Li, 2011). A high degree of exploration in acquisitions poses two key challenges. First, as acquisitions involve irreversible and sunk investment (e.g. premiums), emphasizing a high degree of exploration is unsuitable in fast-changing contexts such as IC that require firms to be flexible in their approach to adaptation (Hsu and Prescott, 2017).

Second, the resources of exploratory targets may be unrelated to firms' internal resources (Choi and McNamara, 2018; Puranam, Singh and Zollo, 2006; Schweizer, 2005). Thus, the post-acquisition integration process may be suboptimal as firms may not possess the appropriate experience to assimilate the unfamiliar hard and soft resources of the target (Chaturvedi and Prescott, 2022; Puranam and Srikanth, 2007; Zollo, 2009). Furthermore, the complex, tedious and resource-intensive nature of integration may divert firms' attention from the more pressing issue of adapting to demand- and supply-side convergence and compromise their position relative to rivals (Barden, 2012; Schriber, King and Bauer, 2022).

In sum, we predict that firms which emphasize a high degree of exploitation in the acquisition growth mode are more likely to benefit from size-related and positional advantages in converging markets and thus would have a higher likelihood of surviving IC.

H3: During a period of IC, emphasizing a high degree of exploitation relative to exploration in the acquisition growth mode will positively affect the likelihood of firm survival.

In support of our hypotheses, we provide qualitative examples in Appendix A.

Empirical context, data and methodology

Our empirical context is a period of both demand- and supply-side IC between the telecommunications equipment (SICs 3661, 3663, 3669) and computer networking (SIC 3576) industries between 1989 and 2003 (Greenstein and Khanna, 1997; Hsu and Prescott, 2017; Lee, 2007; Puranam, Singh and Zollo, 2006). In Appendix B, we describe our empirical context.

Data and variables

We used the COMPUSTAT database to identify firms in both industries and the CORPTECH database to identify firms' product portfolios. We included a firm only if it had a product line in either circuit switching (voice) or packet switching (data) technologies. The sample period began in 1989 when the first integrated data and voice product was introduced and ended in 2003 with the emergence of a new generation of packet switching technologies. This led to a decrease in IC in our sample (Hsu and Prescott, 2017). Our final sample of 231 firms comprised 147 equipment firms and 84 networking firms. We collected performance and control variable data from several sources (Table 1). We gathered data on alliances and acquisitions from the Thompson Financial Securities & Data Commission (SDC) Platinum database. We obtained data on internal development (product market entry) from the CORPTECH database. The total number of growth-mode activities was 3125 (813 market entries, 1548 alliances, 764 acquisitions). Notably, an IC-related context is operationalized in several ways (Kim *et al.*, 2015). As per Hsu and Prescott (2017), we controlled for IC by employing a measure of cross-product market diversification that measures the blurring of industry boundaries by tracking the entry of firms in converging markets (Table 1).

Table 1. Control variables, operationalization and rationale for inclusion

Control variable	Operationalization	Data source	Rationale for inclusion/alternative explanation
Firm size	Natural log of revenue	Compustat	Size influences a firm's likelihood of survival
Firm age	Natural log of the difference between current year and founding year	Compustat	Older firms may have a higher proclivity for exploitation in growth modes
Industry revenue growth	Year-on-year growth in revenue for both product markets (%)	Standard & Poor industry reports	High-growth markets may provide a more munificent context for firms in terms of their likelihood of survival
Industry fixed effects – equipment/networking	Dummy variable coded 1 if SIC code is 3661/63/69 (equipment firms), 0 otherwise (networking firms)	NA	Firms in the equipment and networking markets may have had different approaches to exploration and exploitation in growth modes to ensure survival
Financial insolvency	Measure of potential bankruptcy or financial distress as per Altman's Z score; coded 1 if Z score < 1.81 (i.e. firm nearing bankruptcy), 0 otherwise	Compustat	Bankruptcy is alternative explanation of firm exit and being closer to bankruptcy may decrease the likelihood of survival
Corporate diversification	Natural log of the total number of four-digit SIC codes that a firm was present in	Standard & Poor reports, Mergent Online, IBIS World	Diversified firms may have access to a greater number of resources and converging markets, and hence, a higher likelihood of survival
Degree of IC	$\frac{\sum_{j-1}^{37}(\sum_{i-1}^{28} r_{ij})}{1036}$	CORPTECH	The degree of IC measures cross product market diversification that proxies the intensity of market convergence. In the denominator, $37 \times 28 = 1036$. There were 37 networking markets (j) and 28 equipment markets (i). r_{ij} is the number of firms that were present in a specific product market pair ij concurrently (Hsu and Prescott, 2017)
Tobin's Q	Ratio of the market value of a company's assets (market value of its outstanding stock/debt) divided by replacement cost of assets (book value)	Compustat	Past market performance may affect choice of growth modes and survival
Return on assets (ROA)	Natural log of (operating profits/total assets)	Compustat	Past accounting performance may affect a firm's choice of growth modes and its survival
R&D intensity	Natural log of (R&D expenditure/total revenue)	Compustat	A firm's R&D intensity serves as a substitute for alliances and acquisitions to adapt to IC
Debt-to-equity ratio	Ratio of market value of equity and debt (long-term liabilities + short-term liabilities + current liabilities)	Compustat	Debt-to-equity ratio proxy differences in capital structure and financing approaches
Capital expenditure	Natural log of capital expenditure	Compustat	Capital expenditure represents an alternative form of internal development
Unabsorbed slack	Natural log of (total assets − total liabilities)	Compustat	Firms can deploy slack resources for employing growth modes to ensure their survival
Prior alliance/acquisition/divestiture experience	Cumulative number of all the alliances/acquisitions/divestitures made by a firm	SDC Platinum, Lexis Nexis	Prior alliances, acquisitions and divestitures may positively influence firms to use these growth modes in future
Prior entry experience	Cumulative number of exploratory and exploitative internal product market entry moves	CORPTECH	Firms that enter a larger number of markets using internal development may prefer to use the same mode in the future
Dividend payout decision	Dummy variable coded 1 for the year the firm announced a dividend, 0 otherwise	Compustat	Firms with high-growth orientation may choose not to pay out dividends while firms with a low orientation are stable in dividend payouts

Table 1. (Continued)

Control variable	Operationalization	Data source	Rationale for inclusion/alternative explanation
Stock repurchase decision	Dummy variable – coded 1 for repurchase announcement, 0 otherwise	SDC Platinum, Lexis Nexis	Firms may use stock re-purchases when they have a low-growth orientation and may not find suitable avenues for investment
Investor profile	We operationalized this variable as per the approach of Benner and Ranganathan (2013) (pp. 384–385). This variable takes a minimum value of 1 and a maximum value of 5. Higher values indicate a higher orientation of firms towards long-term revenue growth over short term profitability	Center for Research in Security Prices (CRSP) Survivor-Bias-Free US Mutual Fund Database	Firms that have a greater growth orientation as per investor expectations may be more likely to employ growth modes during IC
International growth mode activities	Natural log of the total number of growth mode activities (i.e. market entries, alliances and acquisitions that were made outside of a focal firm's home country)	SDC Platinum, CORPTECH	International growth mode activities may increase the likelihood of survival due to the benefits of geographical diversification
CEO duality	Dummy variable – coded 1 if the incumbent CEO of a firm was also the chairperson of the board of directors, 0 otherwise	Lexis Nexis, Standard & Poor reports, company websites	CEO duality may give significant power, authority and agency to the CEO to choose growth modes as per their preference and may favourably or adversely impact the likelihood of survival
CEO industry experience	Natural log of the total number of years that a CEO spent working for a firm in the equipment or networking industry	Lexis Nexis, Standard & Poor reports, company websites	A higher level of experience specific to the industries facing IC may enable or disable the CEO from choosing appropriate growth modes to enhance the likelihood of survival
CEO functional background	Dummy variable – coded 1 if the incumbent CEO had an educational or professional background in finance, 0 otherwise	Lexis Nexis, Standard & Poor reports, company websites	CEOs with backgrounds in finance may make a greater number of alliances or acquisitions instead of using internal resources

Independent variables. We operationalized the degree of exploration or exploitation in growth modes as continuous variables, as per the ambidexterity perspective of the exploration/exploitation lens (Chaturvedi, 2023; Lavie, Kang and Rosenkopf, 2011; Stettner and Lavie, 2014). For each growth mode, firms choose activities that are aligned to pure exploration, pure exploitation or a combination of both. Appendix C provides examples of how we coded exploratory and exploitative activities in each growth mode.

Degree of exploration in internal development. For each firm year, we measured internal development using data on the number of equipment or networking markets that a firm entered using data from the CORPTECH database that provides 37 networking product markets and 28 equipment product markets. Exploration in internal development involved firms entering new product markets by introducing new products while exploitation involved firms introducing improved versions of existing products in familiar product markets (Stettner and Lavie, 2014). We coded an activity as exploratory when a firm entered a market for the first time as per CORPTECH. We coded an activity as exploitative when a firm entered a product market based on a familiar technology or if the firm re-entered a product market that it had exited in the past. In both instances, we ensured that our coding approach was robust by tallying the CORPTECH entry with announcements made in archival sources. Using Stettner and Lavie's (2014) approach, we operationalized the degree of exploration as the ratio of the total number of exploratory product market entries to the total number of product market entries (exploratory plus exploitative) for each firm year.

Degree of exploration in alliance growth mode. For each firm year, we coded alliances based on the joint exploration of new technologies, alliances based on new product development or alliances that provided firms

with access to a new market for the first time as exploratory. Next, we coded downstream alliances (manufacturing, marketing, sales or service) as exploitative as they were related to firms intending to employ their partner's downstream resources to increase the market penetration of their existing products. Using Stettner and Lavie's (2014) approach, we created a measure coded 1 for each exploratory alliance and 0 for each exploitative alliance. For alliances that combined exploration and exploitation (e.g. when partners explored a new technology to develop new products and then jointly manufactured, marketed or sold them) we coded the measure as 0.5. We used the average of this measure across all alliances to operationalize the degree of exploration for each firm year.

Degree of exploitation in acquisition growth mode. We coded an acquisition as exploitative and exploratory if the acquired target had a high or low degree of relatedness with the firm's existing business units or products, respectively. As per Stettner and Lavie (2014), first we used the product class and product line codes in CORPTECH to identify 17 product classes comprising 81 product line codes (28 for voice and 53 for data). Next we used the business descriptions of the acquired targets along with the CORPTECH product class and product line codes to code our acquisition measure using a six-point scale. If all four digits of the SIC codes of the acquirer and target were different, we assigned a value of 0 (pure exploration). We assigned a value of 1 if the first digit of their SIC codes was the same, 2 if the first two digits were the same and 3 if the first three digits were the same. If the acquirer and target had the same four-digit SIC codes, we coded the measure 4 if the acquirer was listed in the same product class but not the same product line code as the target in CORPTECH. We coded 5 if the acquirer was listed in both a product class and a product line code similar to the target's (pure exploitation). We used the average of this value across all acquisitions to operationalize the degree of exploitation for each firm year.

Dependent variable. For each firm year, we estimated whether a firm exited (i.e. did not survive) as per the three conditions of Josefy *et al.* (2017). These include: (i) ceasing or discontinuing operations (operations-related exit – 33 firms); (ii) merger or acquisition that ended operational autonomy (ownership-related exit – 68 firms); or (iii) dissolution or bankruptcy (insolvency-related exit – 10 firms). As per Josefy *et al.* (2017), these three conditions have been used extensively by scholars examining firm exit. We operationalized the likelihood of survival using a categorical variable coded 1 for the year when a firm exits due to either of the three conditions, and 0 otherwise. We used Lexis-Nexis and public sources to access the year and reason a firm did not survive. Of the 231 firms, 111 firms did not survive the sample period. The 120 firms that survived were considered right-censored cases.

Empirical methodology

We used event history modelling to test our hypotheses as it is robust to data with right censoring (Allison, 2014; Cleves, Gould and Marchenko, 2016). We estimated the hazard rate of firm exit as the 'event' given the main effect of the degree of exploration and exploitation in the growth modes on the likelihood of firm survival. We used frailty-based event history models that control for firm-specific heterogeneity by controlling for firm-specific effects in the hazard function. Frailty-based models control for any time-dependent omitted variable bias in the dataset (Cleves, Gould and Marchenko, 2016). We used a shared frailty specification as $h(t_{ij}|x_{ij}, \alpha_i) = \alpha_i h(t_{ij}|x_{ij})$, where α_i denotes the frailty, that is, the unobserved, firm-specific (fixed) effect on the hazard rate, i denotes the firm (1, 2, …, n) and j is the jth observation for a firm (1, 2, …, n_i). In a shared frailty specification, the frailties are shared across observations, implying a correlation between different firm-year observations (Cleves, Gould and Marchenko, 2016). We chose a gamma distribution for the functional form of α_i and a proportional hazards Weibull specification for hypothesis testing. A Weibull specification accommodates our prediction as it permits the hazard rate to take a monotonically increasing or decreasing form depending on the degree of exploration in internal development and alliances and the degree of exploitation in acquisitions. We clustered standard errors at the firm level to account for the correlation between error terms across time periods (Cleves, Gould and Marchenko, 2016). We controlled for endogeneity (see Appendix D).

Results

Table 2 shows the correlations and descriptive statistics. Table 3 shows the empirical results. Panel 2a of Figure 2 shows that the cumulative revenue growth for both industries peaked in 2000. Panels 2b–2d show the graphical representations of the results for the three hypotheses. In Table 3, a positive coefficient indicates an increase in the hazard rate of firm exit or a decrease in the likelihood of firm survival. A negative coefficient indicates a decrease in the hazard rate of firm exit or an increase in the likelihood of firm survival.

H1 proposed that during a period of IC, emphasizing a high degree of exploration in the internal development growth mode will positively affect the likelihood of firm survival. It was supported in the full model (model 5: $\beta = -0.30$, $p = 0.021$). If a firm used internal development

Table 2. Correlations and descriptive statistics

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
(1) Firm size	1																										
(2) Firm age	0.12	1																									
(3) Industry growth	0.04	0.00	1																								
(4) Insolvency	−0.05	−0.04	0.00	1																							
(5) Diversification	0.14	0.12	−0.12	−0.00	1																						
(6) IC	0.03	0.00	0.22	−0.01	0.04	1																					
(7) Tobin's Q	0.07	0.03	0.06	0.12	−0.03	0.02	1																				
(8) ROA	0.06	0.05	0.02	−0.05	−0.06	−0.03	0.14	1																			
(9) R&D intensity	0.11	0.05	−0.02	−0.03	0.13	0.08	0.06	0.04	1																		
(10) Debt equity ratio	0.14	0.08	−0.02	0.01	0.02	0.10	−0.01	0.05	0.02	1																	
(11) Capital expenditure	0.10	0.13	−0.05	−0.02	0.06	0.02	0.04	0.01	0.01	0.05	1																
(12) Slack	0.18	0.11	−0.08	0.04	0.13	0.03	0.07	−0.03	−0.04	−0.08	−0.07	1															
(13) Alliance exp.	0.06	−0.06	−0.05	−0.02	0.05	0.05	0.04	0.02	0.06	0.03	−0.02	−0.02	1														
(14) Acqn. exp	0.12	0.05	−0.08	0.02	0.02	0.01	−0.01	−0.06	0.09	0.07	−0.08	−0.01	0.08	1													
(15) Div. exp	0.09	0.03	−0.07	0.07	0.01	0.03	0.03	0.04	0.00	−0.02	0.02	0.05	0.12	0.16	1												
(16) Entry exp	0.03	0.06	−0.09	0.02	−0.02	0.08	0.08	0.05	0.05	0.03	0.04	−0.02	0.02	0.09	0.05	1											
(17) Dividend decision	0.05	0.03	−0.03	0.01	0.04	−0.03	0.01	0.00	0.01	−0.04	−0.02	0.08	0.00	0.02	0.02	0.03	1										
(18) Repurchase	0.02	0.00	−0.02	−0.00	0.09	−0.02	0.02	−0.02	0.00	−0.01	−0.06	0.08	0.00	0.00	0.03	0.01	0.04	1									
(19) Investor profile	0.08	−0.21	0.24	−0.05	0.02	0.05	0.08	0.11	0.12	0.05	0.07	0.05	0.00	0.09	0.05	0.00	0.03	0.10	1								
(20) Intl. growth modes	0.04	0.02	0.09	0.05	0.05	0.02	0.06	0.02	−0.01	−0.02	−0.05	0.03	0.05	0.04	−0.01	0.03	−0.00	−0.01	0.07	1							
(21) CEO duality	0.06	0.04	−0.02	−0.01	0.06	0.00	−0.03	−0.03	−0.06	0.01	−0.07	−0.05	−0.00	0.02	−0.05	−0.01	−0.02	−0.05	−0.00	0.01	1						
(22) CEO ind. Exp	0.02	0.00	0.02	0.01	0.01	−0.03	0.03	0.01	0.08	0.04	0.03	0.01	0.03	0.04	−0.04	0.01	0.00	0.00	0.01	0.07	0.01	1					
(23) CEO back	0.01	0.00	0.00	0.02	0.04	0.01	0.03	0.03	0.01	0.04	0.02	0.02	0.01	0.04	−0.01	0.02	0.01	0.01	0.02	0.01	0.05	0.03	1				
(24) Int dev. – explore	−0.04	0.07	−0.08	−0.12	0.02	0.07	0.03	0.08	0.09	−0.04	−0.06	0.16	0.07	0.12	0.06	0.07	0.09	0.03	0.03	0.00	−0.04	0.06	−0.05	1			
(25) Alliance – explore	−0.02	−0.02	−0.01	0.06	0.05	0.03	0.05	0.05	0.02	−0.01	−0.03	−0.00	−0.17	0.01	−0.00	0.02	−0.02	0.01	0.04	0.01	−0.02	0.02	−0.01	0.11	1		
(26) Acqn – exploit	0.09	0.06	−0.07	0.04	0.06	0.06	−0.03	0.06	−0.03	−0.02	−0.05	−0.14	0.07	0.19	−0.16	0.05	−0.02	−0.08	0.03	0.02	0.07	0.05	0.04	0.02	−0.00	1	
(27) Firm exit	−0.03	−0.02	−0.03	−0.02	−0.03	0.07	−0.13	0.06	−0.02	0.06	0.02	−0.07	−0.03	0.02	0.54	0.10	0.04	−0.04	−0.05	−0.07	0.02	−0.01	−0.02	−0.03	0.00	−0.05	1
Mean	1.06	0.18	0.14	0.64	0.27	0.23	0.24	0.75	0.08	0.34	0.33	2.97	1.14	0.26	0.12	0.20	0.09	0.21	3.04	0.96	0.44	1.74	0.32	0.36	0.43	0.41	0.03
SD	1.13	0.16	0.19	0.48	0.44	0.17	0.26	1.56	0.60	1.14	1.29	0.11	0.49	0.14	0.25	0.62	0.28	0.53	0.52	1.72	0.21	2.29	0.19	0.29	0.26	0.28	0.16
Minimum value	0.68	0.13	−0.17	0	0	0	−0.51	0.01	−2.83	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	1	0	0	0	0	0.00	0.00	0.00	0
Maximum value	4.72	0.52	0.85	1	1	0.49	1.06	1.60	7.26	1.18	2.22	126	97	24	18	1	1	1	5	3.55	1	3.68	1	0.68	0.71	0.77	1

All correlation values (positive and negative) > 0.08 are significant at p < 0.05. N = 4200 firm years.

Table 3. Event history modelling results – proportional hazards Weibull regression (endogeneity adjusted estimates)

	Model 1 (controls)	Model 2 (H1)	Model 3 (H2)	Model 4 (H3)	Model 5 (full model)
H1: Degree of exploration in internal development		**−0.36*(0.15)**			**−0.30*(0.13)**
H2: Degree of exploration in alliances			**−0.42**(0.13)**		**−0.37*(0.15)**
H3: Degree of exploitation in acquisitions				**−0.53**(0.19)**	**−0.44**(0.16)**
Firm size	−0.92**(0.30)	−0.99**(0.37)	−0.91*(0.42)	−1.11*(0.47)	−0.89**(0.32)
Firm age	−0.60***(0.17)	−0.58***(0.18)	−0.56***(0.15)	−0.44**(0.15)	−0.40**(0.14)
Industry revenue growth	−0.33*(0.14)	−0.46*(0.20)	−0.35**(0.11)	−0.38**(0.14)	−0.33*(0.16)
Financial insolvency	0.27***(0.05)	0.23***(0.06)	0.20*(0.09)	0.19**(0.07)	0.16***(0.04)
Corporate diversification	0.04(0.11)	0.11(0.15)	−0.09(0.14)	−0.10(0.13)	−0.13(0.17)
Degree of IC	0.61**(0.19)	0.55**(0.19)	0.60***(0.16)	0.61***(0.15)	0.59**(0.20)
Tobin's Q	−0.53**(0.17)	−0.43*(0.21)	−0.51*(0.23)	−0.49^{+}(0.28)	−0.55*(0.25)
ROA	−0.66(0.47)	−0.58(0.66)	−0.59(0.64)	−0.83(0.67)	−0.87(0.70)
R&D intensity	−0.13(0.11)	−0.09(0.22)	−0.13(0.19)	−0.09(0.20)	−0.13(0.11)
Debt equity ratio	0.18^{+} (0.10)	0.17^{+} (0.10)	0.15 (0.11)	0.17(0.11)	0.13(0.09)
Capital expenditure	−0.12(0.14)	−0.06(0.12)	−0.09(0.12)	−0.06(0.13)	−0.10(0.13)
Unabsorbed slack	−0.30**(0.11)	−0.35***(0.09)	−0.31**(0.10)	−0.29***(0.08)	−0.37***(0.09)
Prior internal development (entry) experience	−0.22(0.22)	−0.04(0.07)	−0.22(0.18)	−0.26(0.31)	−0.27(0.28)
Prior alliance experience	−0.09(0.07)	−0.08(0.11)	−0.05(0.05)	−0.11(0.16)	−0.10(0.14)
Prior acquisition experience	−0.11(0.12)	−0.11(0.09)	−0.07(0.08)	−0.09(0.08)	0.14(0.15)
Prior divestiture experience	0.04(0.07)	0.13(0.17)	0.23(0.19)	0.16(0.16)	0.13(0.11)
Dividend payout decision	−0.20(0.17)	−0.08(0.08)	−0.14(0.12)	−0.13(0.16)	−0.19(0.21)
Stock repurchase decision	0.44(0.46)	0.20(0.41)	0.53(0.44)	0.49(0.56)	0.47(0.59)
Investor profile	−0.60***(0.14)	−0.55**(0.18)	−0.53***(0.14)	−0.58***(0.17)	−0.51***(0.14)
International growth mode activities	−0.34(0.45)	−0.21(0.33)	−0.24(0.29)	−0.18(0.26)	−0.15(0.22)
CEO duality	0.08(0.13)	0.11(0.15)	0.13(0.18)	0.16(0.20)	0.12(0.14)
CEO industry experience	0.17(0.21)	0.23(0.22)	0.21(0.17)	0.25(0.31)	0.27(0.19)
CEO functional background	−0.15(0.19)	−0.17(0.20)	−0.20(0.25)	−0.23(0.28)	−0.22(0.24)
Endogeneity residual – exploration versus exploitation		−0.13*(0.06)	−0.18*(0.08)	−0.31*(0.14)	−0.29*(0.12)
Endogeneity residual – alliance		−0.09(0.11)	−0.08(0.12)	−0.09(0.09)	−0.12(0.15)
Endogeneity residual – acquisition		−0.05(0.08)	−0.05(0.19)	−0.03(0.04)	−0.09(0.09)
Year, industry and firm fixed effects	Included	Included	Included	Included	Included
Wald χ^2	227.42***	298.66***	305.12***	324.70***	408.04***
Log pseudo-likelihood	11.69	27.54	33.62	40.13	51.94
Frailty model over-dispersion parameter θ	0.005	0.0001	0.0001	0.0001	0.0003
Weibull scale parameter (p)	2.16	4.73	5.49	6.36	8.20

Notes: (a) The value in brackets is the robust, heteroscedasticity-adjusted standard error that also controls for frailty (unobserved heterogeneity). (b) Bold values refer to hypotheses test results. (c) While interpreting the results, an increase in the likelihood of firm survival is given as 1/ (1 − δp(exit)), with δp(exit) implying a decrease in the hazard rate of firm exit. (d) We report the log pseudo-likelihood and Wald χ^2 statistic as event history models do not provide log likelihood and likelihood ratio tests when robust standard errors are used.

$^{+}$p < 0.1.

*p < 0.05.

**p < 0.01.

***p < 0.001.

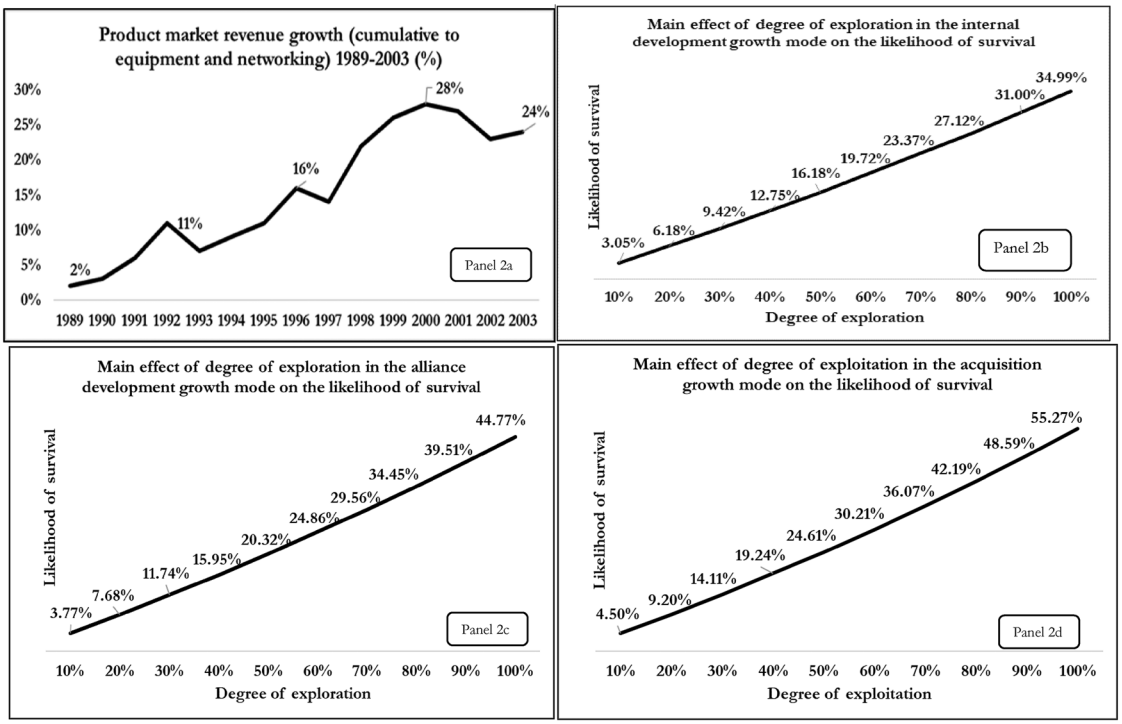

Figure 2. Empirical context and graphical representation of hypothesized effects. *Panel 2a shows the revenue growth in equipment and networking product markets on a cumulative basis. Panels 2b–2d show the main effects of the degrees of exploration in the internal development and alliance growth modes and the degree of exploitation in the acquisition growth mode on the likelihood of survival, respectively*

exclusively for exploration, that is, the degree of exploration was 100%, the likelihood of survival increased by about 35%, a little more than one-third ($1/\exp(-0.30) - 1 = 0.35$). Panel 2b of Figure 2 shows that the likelihood of survival increased from about 3% to about 35%, respectively, as the degree of exploration increased from 10% to 100%.

H2 proposed that during a period of IC, emphasizing a high degree of exploration in the alliance growth mode will positively affect the likelihood of firm survival. It was supported (model 5: $\beta = -0.37$, $p = 0.014$). If a firm used alliances exclusively for exploration, the likelihood of survival increased by about 45%. Panel 2c of Figure 2 shows that the likelihood of survival increased from about 4% to 45%, respectively, as the degree of exploration increased from 10% to 100%.

H3 proposed that during a period of IC, emphasizing a high degree of exploitation in the acquisition growth mode will positively affect the likelihood of firm survival. It was supported (model 5: $\beta = -0.44$, $p = 0.006$). If a firm used acquisitions exclusively for exploitation, the likelihood of survival increased by about 55%. Panel 2d of Figure 2 shows that the likelihood of survival increased from 4% to about 55%, respectively, as the degree of exploitation increased from 10% to 100%.

Our results were robust to several checks discussed in Appendix E.

Discussion

Theoretical contribution

Contribution to research on IC. Notwithstanding that IC is a novel form of technological change that differs from more conventional contexts, prior work has only hinted at the importance of growth modes for improving firm performance during IC (Benner and Tripsas, 2012; Hsu and Prescott, 2017; Lee, 2007). Scholars have stressed the salience of examining this issue in detail as IC has affected several industries globally (Kim *et al.*, 2015; Sick and Bröring, 2022). Our study addresses this call by developing theoretical and empirical insight on how firms employ growth modes to survive IC. We show that when firms appropriately emphasize growth mode attributes such as the degree of exploration and exploitation to demonstrate ambidexterity within and across multiple growth modes (internal development, alliances and acquisitions), they may increase their likelihood of surviving IC.

For instance, the results of models 2–4 in Table 3, respectively, indicate that firms which emphasized a high degree of exploration *within* internal development and alliances and a high degree of exploitation *within* acquisitions could potentially increase their likelihood of survival by nearly 43%, 51% and 70%, respectively (ambidexterity within individual growth modes). However, the results of model 5 (full model) show that firms

which *simultaneously* emphasized a high degree of exploration within internal development and alliances and a high degree of exploitation within acquisitions increased their likelihood of survival by almost 35%, 45% and 55%, respectively (ambidexterity across multiple growth modes). These improvements are non-trivial in the context of IC, a phenomenon endemic to several industries and one that has grave implications for firm survival. Our results illustrate that firms which demonstrated ambidexterity by appropriately emphasizing exploration and exploration within and across growth modes were more likely to increase their chances of surviving IC. In addition, the capability to do so could have been the difference between the winners and losers of IC in our study.

Interestingly, our results depart from the findings related to other contexts of technological change, where exploration of a newly emerging technology has been found to be more conducive to firm survival (Ansari and Krop, 2012; Christensen *et al.*, 2018; Eggers and Park, 2018). In comparison, the exploitation of an existing technology has found limited support as a survival mechanism only in specific contexts, such as when technological substitution is delayed (Adner and Kapoor, 2016), when incumbents with an existing legacy technology possess complementary resources (Roy and Cohen, 2017), or where the legacy technology is 'pre-adapted' to compete in other contexts (Raffaelli, 2019). In contrast, our finding for H3 demonstrates that exploitation is an important enabler of firm survival during IC, particularly when it is carried out via acquisitions, whereby it provides firms with size-related and positional advantages to compete with new rivals that emerge as a result of IC.

Overall, our results endorse the survival-enhancing importance of demonstrating ambidexterity within and across multiple growth modes during IC, in contrast to *solely* emphasizing exploration within growth modes and downplaying exploitation – as has been the remit of prior work on technological change. Our results are in accordance with prior research on ambidexterity in growth modes (Chaturvedi, 2023; Greve, 2007; He and Wong, 2004; Lavie, Kang and Rosenkopf, 2011; Phene, Tallman and Almeida, 2012; Stettner and Lavie, 2014). Thus, we advance a new research frontier on IC that demonstrates how ambidexterity within and across multiple growth modes represents a potent alternative for firms to survive IC.

The practical importance of our results may be illustrated from the material patterns in our data. We found that examining the aggregate number of growth-mode activities employed by our sample firms led to a puzzling conclusion. Over the sample period, on average, each firm employed about 14 growth-mode activities to adapt to IC (about four market-entry activities, seven alliances and three acquisitions). That is, on average, firms employed one activity each year. Yet 48% of our sample firms did not survive the sample period. While firms seemed to heed the prescription that growth modes are important for survival during IC, simply employing an aggregate of growth-mode activities was necessary but not sufficient to guarantee survival.

A deeper examination of the material patterns revealed that firms which survived demonstrated ambidexterity by emphasizing the appropriate degree of exploration and exploitation within and across internal development, alliances and acquisitions. For instance, surviving firms employed a degree of exploration of 61% and 72% on average within internal development and alliances, respectively, and a degree of exploitation of 69% on average within acquisitions. The corresponding average figures for firms that did not survive were 43%, 59% and 54% for internal development, alliances and acquisitions, respectively. In addition, 88% of the surviving firms *simultaneously* emphasized a high degree of exploration in internal development and alliances and a high degree of exploitation in acquisitions, in contrast to non-surviving firms for whom the corresponding figure was 2%. Some prominent firms that survived our sample period were Cisco, ADC and 3Com (Appendix F). Thus, our findings and the material patterns in our data indicate that examining the attributes of growth modes provides a more compelling explanation of the difference in survival outcomes of firms during IC in comparison to examining aggregate numbers of growth-mode activities.

Finally, employing IC, an increasingly pervasive type of technological change as a context enabled us to illustrate that it merits the attention of strategy scholars in alignment with prior research on this topic (Diamandis and Kotler, 2020; Kim *et al.*, 2015; Sick and Bröring, 2022). We invite further research on IC as it may enable us to better understand the broader question of firm adaptation during technological change and how heterogeneity in firm outcomes evolves during these periods.

Contribution to research on growth modes. Recent research has found that firms employ different corporate development modes to achieve performance-related outcomes in a concurrent fashion (Capron and Mitchell, 2009; Stettner and Lavie, 2014). Our study extends this body of work to the context of IC. The findings and material patterns in our data illustrate that over time, the concurrent employment of multiple growth modes is particularly critical for survival when firms demonstrate ambidexterity by appropriately emphasizing exploration or exploitation within and across growth modes. For instance, from the material patterns discussed in the previous subsection, the concurrent use of growth modes by surviving firms was considerably different from that of firms that did not survive.

Survivors simultaneously emphasized a higher degree of exploration in internal development and alliances and a higher degree of exploitation in acquisitions relative to non-survivors.

Thus, our study emphasizes the importance of developing theoretical insight into how the concurrent use of growth modes differs across firms over time and how these differences drive heterogeneity in firm outcomes in different environments. As a starting point, our study shows that one antecedent to why the concurrent use of growth modes differs over time relates to how firms demonstrate ambidexterity by relatively emphasizing exploration and exploitation within and across multiple growth modes to increase their likelihood of survival during IC. We suggest that subsequent research examines the concurrent deployment of growth modes given alternative antecedents. This may lead to richer theoretical insights on how the concurrent use of growth modes drives firm outcomes and heterogeneity. Finally, our study adds to prior research that reinforces the need for firms to build the capability to develop and effectively deploy multiple growth modes in a concurrent fashion to access resources to adapt to technological change (Capron and Mitchell, 2009; Chaturvedi and Prescott, 2022).

Limitations and future research

The limitations of our study provide interesting opportunities for future research. First, we emphasize that our work is foundational and there is significant scope for future research to examine alternative strategies that firms adopt to survive IC. For instance, artificial intelligence and climate change are inevitably resulting in the blurring of industry boundaries and leading to new instances of IC (Diamandis and Kotler, 2020; Park and Heo, 2020; Sick and Bröring, 2022). In addition, as firms make sense of these developments, they need to rethink their emphases on exploration or exploitation when facing new contexts of IC. Furthermore, how IC unfolds in these contexts – and how firms develop adaptive strategies to respond – may alter the way in which institutions and individuals consume products and services, bearing implications for how nations change as a result (Inkeles, 2019).

Second, we acknowledge that employing product market and product-related data to operationalize the degree of exploration in internal development and alliances and the degree of exploitation in acquisitions is one of several possible approaches to capture exploration and exploitation. Subsequent research may consider employing alternative measures of exploration and exploitation to examine how firms adapt to and survive IC.

Third, our study shows that whether firms emphasize a high degree of exploration or exploitation while demonstrating ambidexterity within and across multiple growth modes may be contingent on the specific performance outcome under study. For instance, Stettner and Lavie (2014) found that a high degree of exploration in alliances and acquisitions and a high degree of exploitation in internal development positively affected a firm's market performance. Likewise, He and Wong (2004) and Greve (2007) found that balancing the degree of exploration and exploitation in internal development positively affected revenue growth and product innovation. Lastly, Wassmer, Li and Madhok (2017) found that balancing the degree of exploration and exploitation in alliances positively affected operating profit margin. These results contrast with our findings, where we examined the likelihood of firm survival during IC as an outcome of interest. Hence, we suggest that there is a need for more fine-grained theoretical insights into how ambidexterity via the relative emphasis on exploration and exploitation within and across growth modes differently affects different performance outcomes.

In conclusion, by theorizing how firms demonstrate ambidexterity within and across their growth modes, and strive to improve their likelihood of survival during IC, our study opens a new frontier for research on IC. We hope scholars will apply other theoretical lenses to examine how growth modes affect firm survival during IC, as doing so may develop greater theoretical insight on how firms survive IC. For scholars and managers alike, our study shows the importance of firms concurrently employing multiple growth modes to successfully navigate the choppy waters of IC.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section at the end of the article.