Making obsolescence obsolete: Execution of digital transformation in a high-tech manufacturing SME

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A B S T R A C T
Digitally transformed firms show resilience against environmental volatility by regularly developing adaptive capabilities and transforming their processes to mitigate the effects of obsolescence. However, there is a lack of conceptual clarity on the obsolescence notion and means of avoiding it. This paper aims to investigate how firms’ empirical sensitivities to evolving environmental changes emerge and materialize into the ongoing management of obsolescence. We undertook an interpretive longitudinal study between 2009 and 20, capturing both the transformation journey and the habitus of a high-tech SME, which is a family business and located in the UK. In doing so, we develop an integrative framework to explain the interplay between the noncognitive dynamic capabilities, obsolescence, and digital transformation. This study has important implications to boost SMEs’ capacity to counter obsolescence. We suggest managers pay attention to the development of noncognitive dynamic capabilities. This, in turn, inadvertently leads to successful digital transformation for obsolescence trap avoidance.

1. Introduction

The fast pace of change in technology and innovation creates waves of disruption across various industries as the obsolescence puzzle has become a focal issue for firms (Del Giudice et al., 2021). Obsolescence arises when a new service, product, or technology replaces an older one (Jain, 2016) such as the introduction of digital music downloads, which replaced compact discs (CDs) (Amankwah-Amoah, 2017). Obsolescence hinders a firm’s ability to adapt to the unprecedented changes in the environment, which may lead to deteriorating performance and viability (Chen & Yu, 2021; Le Mens, Hannan, & Polos, 2015) and makes firms slowly lose dynamic capabilities (DCs) as a result of the obsolescence of technologies and knowledge (Chen & Yu, 2021; Westerman & Bonnet, 2015). As such, the capacity to make obsolescence obsolete is becoming strategically important for firms to survive and thrive in today’s rapidly changing environment.

However, there is a lack of conceptual clarity on the underlying design logic of digitally transformed firms. Digitally transformed firms are expected to be resilient against volatility in the environment by regularly developing adaptive capabilities and transforming their processes to mitigate the effects of obsolescence (Amankwah-Amoah, 2017). While obsolescence has been recognized as a prominent organizational problem (Chen & Yu, 2021), and a risk (Agarwal & Helfat, 2009), many firms are struggling to understand the obsolescence concept and means of avoiding it. To address these issues, we aim to develop a framework for managing obsolescence in the context of digital transformation.

One of the main causes of obsolescence is highlighted as organizational insensitivity to the changes in the environment. Indeed, Warrington (1974: 97) highlights that ‘if those in control of the organisation are sensitive to changes, and if they re-define their objectives from time to time as circumstances dictate, then the organisation can be adapted to the changing objectives so that obsolescence will be avoided.’ However, there are several challenges in identifying the inception of obsolescence, diagnosing root causes, and developing remedies for business viability. The development and renewal of DCs have the potential to help firms engage with strategic initiatives to digitally transform their businesses to avoid obsolescence. Although technological change, digital transformation, DCs, and obsolescence are closely linked concepts (Del Giudice et al., 2021), little is known as to how firms address the obsolescence puzzle while digitally transforming.

The path dependency characteristics of DCs would seem to lock a
firm into cognitions that tend to be static (Volberda, Foss, & Lyles, 2010) and not able to avoid obsolescence. Recent research has focused on DCs as routines and linked them with digital transformation (Warner & Wäger, 2019) but has not adequately investigated how digital transformation originates from adaptive capabilities at the organizational level from the ‘non-cognitive intelligence, learning, and adaptive action’ (Nayak, Chia, & Canales, 2020: 282) to counter obsolescence. As such, the noncognitive capabilities research domain is particularly interesting to analyze in terms of digital transformation, which entails leveraging digital technologies to fundamentally transform value creation and appropriation processes (Alessia, De, Federico, Petrazzelli, & Angelo, 2020).

The digital transformation process comprises three phases: 1) digitization, 2) digitalization, and 3) digital transformation (Verhoef et al., 2021) and the execution of these phases is much harder than defining a digital strategy (Alessia et al., 2020; Sebastian et al., 2017). This notion has been supported by Baculard, Colombani, Flam, Lancy, and Spaulding (2017), who claim that only five percent of digital transformations achieve the expected outcomes. Furthermore, content and adaptive capabilities can vary during digital transformation according to the contingencies (i.e., size, industry) and technological changes in which firms are embedded (Lobo & Whyte, 2017; Granados & Gupta, 2013). With the emergence of the increasing need for new adaptive capabilities, coping with the challenges of digital transformation has become a foremost concern, particularly for small and medium-sized enterprises (SMEs) (Vanherbeke, 2017). Although there is a growing body of literature examining obsolescence by focusing on large firms (e.g. Chen & Yu, 2021; Popa, Soto-Acosta, & Palacios-Marqués, 2021), a shortcoming in the literature is the relative lack of a comprehensive conceptual framework to account for how SMEs execute a digital transformation to avoid obsolescence (Chen & Yu, 2021; Del Giudice, 2021; Peter, Kraft, & Lindeque, 2020; Loonam, Eaves, Kumar, & Parry, 2018; Müller, Buliga, & Voigt, 2018). Thus, the purpose of this research is to better understand the adaptive capability - what Nayak et al. (2020) call non-cognitive capabilities - underpinning the execution of digital transformations to counter obsolescence in SMEs. Specifically, we seek to enrich the literature by investigating the transformation journey of a high-tech, manufacturing SME. In doing so, we ask: How do high-tech manufacturing SMEs execute digital transformations to avoid obsolescence? And what are the associated noncognitive dynamic capabilities?

We aim to explore the longitudinal aspects of adaptive capabilities, such as their idiosyncratic trajectories and patterns, and the underpinning impact on digital transformation processes. To answer our research questions, we have drawn on the noncognitive dynamic capabilities (DCs) literature (Nayak et al., 2020; Peteraf, Di Stefano, & Verona, 2013; Teece, Pisano, & Shuen, 1997). We adopt longitudinal, qualitative research that is conducted over ten years, and grounded in the analysis of a high-tech SME, which is a mature family business based in the UK.

There are three key contributions to the literature and practice. First, we conceptualize and define the link between obsolescence and the digital transformation process. We offer a conceptual framework to explain the interplay of the adaptive capabilities, namely empirical sensitivities and habitus, in the context of a digitally transformed SME. Second, we contribute to the DCs literature and provide empirical insights into what types of noncognitive capabilities might be required for digital transformation phases. Using Nayak et al. (2020) noncognitive DCs perspective, we explain the digital transformation processes. We develop a framework that shows the types of noncognitive capabilities needed for the execution of digital transformation phases to counter obsolescence. Third, our study has important implications for practice. We identify that strategic selectivity, (re)focus, and affinity with the innovation ecosystem, together with perennial ethos, are typically transmitted and shared unconsciously through social practices rather than through formal instruction. They provide the foundations of noncognitive DCs. SME managers should pay attention to these empirical sensitivities to effectively respond to digitalization trends by orienting their employees toward careful management of obsolescence in a manner unique to the firm’s history and experiences.

This paper proceeds by first providing a review of the relevant literature, linking the concepts of obsolescence, digital transformation, and the noncognitive aspects of DCs. It then provides an overview of our single case study and qualitative methods before presenting our integrative framework. We conclude by discussing our empirical findings, establishing what this means for DCs theory and managerial practice, and developing future research suggestions.

2. Theoretical background

2.1. Obsolescence management in a technology-driven environment

A growing body of literature focuses on technological turbulence, defined as the rate of technological shifts accelerated by Industry 4.0 (Day & Schoemaker, 2016; Yoo, Boland, Lyytinen, & Majchrzak, 2012). This unprecedented technological shift is seen as the new normal and is relevant as a source of rapid change, which can pose a threat to firms that do not demonstrate the required adaptive capabilities (Chen & Yu, 2021; Reeves, Love, & Mathur, 2013). Although Industry 4.0 is referred to as beginning in the early 2000s, digitization trends have been happening in organizations since the 1950s (Lele, 2019). Today, digital technologies change the way we conduct business across many domains threatening the business models of many successful firms across industries (Müller et al., 2018; Weill & Woerner, 2015). Research indicates that several industries have already experienced digital disruption such as music, software, telecommunications, publishing, hospitality, and consumer electronics, or are highly susceptible to disruption (e.g., banks, insurers, and health care providers) (Grossman, 2016). Digital disruption refers to transformation processes, where innovation fundamentally alters historically sustainable logic for value creation and appropriation. Therefore, firms need to have the necessary sensitivities and capabilities to be prepared for either disrupting industries themselves or exploiting the emerging changes if they aim to remain viable in the digital era (Skog, Wimelius, & Sandberg, 2018).

Digital transformation is offered as a solution to build adaptability in the environment (Alessia et al., 2020; Shen et al., 2019; Heavin & Power, 2018; Müller et al., 2018). Digital transformation has three phases: digitization, digitalization, and digital transformation (Verhoef et al., 2021). Digitization refers to the encoding of analog information into a digital format, whereas digitalization is the wider adoption of converting existing business processes into digital counterparts at the institutional level (Verhoef et al., 2021; Yoo et al., 2012). Digital transformation is a result of ‘the combined effects of several digital innovations bringing about novel actors (and actor constellations), structures, practices, values, and beliefs that change, threaten, replace or complement existing rules of the game within organizations, ecosystems, industries or fields’ (Hnings, Gegenhuber, & Greenwood, 2018: 53). Firms that are not able to keep up with uneven technological change gradually lose their core competencies due to the obsolescence of knowledge, technologies, and products (Chen & Yu, 2021; Popa et al., 2021). Therefore, rapid environmental change, digital transformation, and obsolescence are closely linked concepts that managers should pay attention to.

Many authors have come up with different methods and tools to manage obsolescence that unfolds over time. For example, Chen and Yu (2021) suggest that SMEs should only implement exploitation-focused innovations and larger firms should pursue exploratory innovations to avoid obsolescence. Also, Huns (1995) explains that during the renewal cycle, managers cannot directly manage change. They can only manage the organization’s ability to change that is to prevent obsolescence. Furthermore, Rojo, Roy, Shehab, and Wardle (2009) point out that planning and managing the firm’s responses are the only ways to mitigate the risk and minimize the impact of obsolescence. Hence, firms must have processes and capabilities to manage obsolescence.
proactively (Del Giudice et al., 2021). As Adetunji, Bischoff, and Willy (2018) point out, obsolescence is here to stay as digitalization and technological turbulence continue to rise. However, there is an over-emphasis on technology both in literature and in practice (Heavin & Power, 2018). Therefore, we need more research into broader organizational considerations as suggested by Heavin and Power (2018).

2.2. Characterizing the obsolescence concept

Rapid technology changes coupled with short product lifecycles create both challenges and opportunities for organizations (Chen & Yu, 2021; Rai & Terpenny, 2008). Advances in technology lead to obsolescence in older versions of the products. Obsolescence occurs when elements of a system become outdated, which can have operational, and cost implications (Adetunji et al., 2018). According to Rai and Terpenny (2008), obsolescence is a phase in a product’s lifecycle, where the product is less valuable or no longer wanted, although it might still be in good working condition and fulfilling its intended purpose.

Product obsolescence usually occurs due to technological obsolescence (Amankwa-Amaoh, 2017; Rai & Terpenny, 2008) caused by customers being attracted to newer functions in products. Moreover, some parts, particularly those incorporated in electronics products, have a lifecycle that must be taken into account when examining technology obsolescence. These electronic parts may have a shorter lifespan than the products they support (Bartels, Ermel, Sandborn, & Pecht, 2012). Therefore, due to technological products getting more complex and modular, it is essential to think about the system holistically to implement collective action to manage obsolescence (Heavin & Power, 2018; Chung, Han, & Sohn, 2012). Thus, as technological dependencies are getting complex, there is a need for ecosystem thinking to manage integration effectively (Peter et al., 2020).

Obsolescence management has both proactive and reactive features that can be planned or unplanned. Ideally, obsolescence management would be proactive (Del Giudice et al., 2021); however, in practice, unplanned obsolescence often occurs as a reactive approach to rapid changes in the environment and technology (Adetunji et al., 2018; Cooper, 2004). Managers do not usually have enough time to plan for obsolescence as it can be difficult to anticipate change. However, SMEs and larger firms operating in a technology-driven environment need to address obsolescence proactively if they want to compete and thrive as reactive approaches to rapid changes in the environment as the products are not built to last (Guiltinan, 2009).

On the other hand, planned or built-in obsolescence is used as a strategy embedded into the design of the product (Amankwa-Amaoh, 2017). Planned obsolescence denotes a deliberate attempt to restrict the lifecycle of a product (Cooper, 2004). Bill Gates, the founder of Microsoft, once highlighted that only those firms that make their products obsolete before others will be successful (Bartels et al., 2012). Some firms try to produce products that become obsolete in a short period. In that way, they reduce the product lifecycle to avoid technological evolution and entice customers to buy new products regularly. However, planned obsolescence has significant detrimental effects on the environment as the products are not built to last (Guiltinan, 2009).

In sum, obsolescence is often characterized by declining capability (Cheng and Yu, 2021; Heavin & Power, 2018; Le Mens et al., 2015) and digital transformation can, itself, be seen as a dynamic capability (Del Giudice et al., 2021; Dezi, Pisano, Pironti, & Papa, 2018). Nevertheless, research into obsolescence is a persistent gap in the literature (Chen & Yu, 2021; Jain, 2016; Le Mens et al., 2015). Therefore, there is a call for more longitudinal and qualitative studies to understand the tacit mechanisms underpinning successful digital transformations and related DCs to counter obsolescence in the context of SMEs (Del Giudice et al., 2021; Papa, Chierici, Ballestra, Meissner, & Orhan, 2020; Smith & Beretta, 2020; Jain, 2016; Chia & MacKay, 2007; Naldi, Wikström, & Von Rimscha, 2014).

2.3. A noncognitive dynamic capabilities perspective

To appreciate the firm-environment nexus and explain how firms execute digital transformation, we focus on dynamic capabilities (DCs) theory (Teece et al., 1997). Teece and his colleagues define DCs as ‘the firm’s ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments’ (Teece et al., 1997: 516). DCs are predominantly applicable to dynamic and highly competitive environments, characterized by innovation, price-based competition, and creative destruction (Li & Liu, 2014; Teece et al., 1997). DCs are said to allow better decision-making in an environment that is volatile but attractive (Li & Liu, 2014). In this view, a very limited number of studies in the emergent literature have addressed how SMEs operating in volatile environments develop and reinvent the above-mentioned capabilities (Del Giudice et al., 2021).

As our understanding of DCs has progressed, so too have efforts to conceptualize them within different contexts. For example, Eisenhardt and Martin (2000) identify differences between medium and high-velocity markets. They argue that, in volatile industries, DCs are based on existing knowledge, are very complicated, analytical, and generate a predictable outcome. In high-velocity markets, structures are blurred, DCs rely on quickly created new knowledge and iterative execution, are experiential, and produce adaptive outcomes. Although Teece (2012: 1399) identifies DCs as ‘non-routine’ and entrepreneurial, Eisenhardt and Martin (2000) associate DCs with notions of routines, best practices, and substitutable competencies.

However, some researchers criticize the DCs framework as it can be vague, and non-operational (Priem & Butler, 2001). Indeed, their tacit nature makes them difficult to research empirically (Li & Liu, 2014; Peteraf et al., 2013). However, supporters of this theory dispute the critics and prove with empirical research that DCs have management applicability (Eisenhardt & Martin, 2000; Warner & Wäger, 2019).

To address this issue, research suggests that it is important to go beyond the concepts of analytical best practices and routines (Eisenhardt & Martin, 2000) and focus on a firm’s ‘collectively shared, historically shaped practices and predispositions’ (Nayak et al., 2020: 284) to understand noncognitive aspects of DCs. Nayak et al. (2020: 282) argue that ‘a finely honed sensitivity to changing environmental conditions and the corresponding development of a set of generic coping skills are what underpins dynamic capabilities’. Hence, they suggest that empirical sensitivity and habitus are the two key concepts to study the underpinnings of noncognitive DCs. We need to investigate firms’ empirical sensitivities that reflect their distinctive collective history and experiences to explain noncognitive DCs.

The first notion, habitus, is one of Bourdieu’s most influential concepts and refers to the physical embodiment of cultural capital, to the deeply rooted habits, skills, and dispositions that we possess due to our life experiences (Bourdieu, 1990). In an organizational context, habitus provides consistency in collective actions (Spinosa, Flores, & Dreyfus, 1997). This explains the non-deliberate coordination and orchestration of productive actions within a collective. Accordingly, a firm’s habitus is ‘the product of a complex history of accumulated practices and an associated set of predispositions and tendencies’ (Nayak et al., 2020: 290). It is important to explain that habitus is linked to DCs because capabilities result from a historical learning process involving past experiences (Del Giudice et al., 2021) that drive decisions and internalized practices. In other words, habitus comprises the repository of cumulative practices that have proved successful or unsuccessful over time and is unique to a particular firm. Thus, the habitus is internal responsiveness nurtured through the collective and complex history of a firm and associated with empirical sensitivities, predispositions, and tendencies.

Second, empirical sensitivity represents heightened adaptations to environmental changes (Nayak et al., 2020; Day & Schoemaker, 2016; Peteraf et al., 2013). Empirical sensitivities are linked to DCs because they represent a collectively shared and finely honed observational capacity to differentiate among situations and make decisions accordingly.
In doing so, empirical sensitivities and the firm’s habitus are interlinked as both concepts reflect collective learning and experiences that enable firms to integrate, build and reconfigure internal and external competencies to address rapidly changing environments (Teece et al., 1997).

In this view, our theoretical approach goes beyond best practices and reflects how DCs need to manage the digital transformation to avoid obsolescence originating from the accumulation of everyday actions (Chia & Holt, 2006). These actions are embodied in the firm through its shared history and experiences (Del Giudice et al., 2021). From an organizational perspective, the repository of previous experiences aggregates into a set of collective predispositions and tendencies (habitus), and a refined judgment for a certain action (empirical sensitivities) that is unique to the firm. Empirical sensitivities and habitus have reciprocal relations as empirical sensitivities ‘generate’ habitus and in return, habitus’ constrains’ empirical sensitivities (Bruineberg & Rietveld, 2014:4). This line of conceptualization and inquiry requires a qualitative, longitudinal analysis (Papa et al., 2020; Naldi et al., 2014) and the aforementioned theoretical approach will guide our empirical examination, which we will discuss next.

3. Methods

The longitudinal and interpretive approach applied attempts to make sense of SME managers’ lived experiences and reflections, in their broader and often unique historical context (Chia & MacKay, 2007). This calls for a study, which enables concentration on a single case over a period of time, necessary for an in-depth, intensive description, analysis, and interpretation of data. This is the main purpose of using a longitudinal single case to go deeper and better understand digital transformation to avoid obsolescence and ‘a case study is an intensive study of a single unit to understand a larger class of (similar) units’ (Gerring, 2004, p. 342). Hence, this study is based on deep collaboration with a UK-based high-tech SME that manufactures high-end home entertainment and music systems.

3.1. Case selection

Our study explores a manufacturing SME that has, surprisingly, managed to survive the uneven technology shifts in a highly dynamic consumer electronics industry since 1973. Our case firm is interesting because, for an SME to restrain obsolescence, the firm should be able to reproduce its adaptive capability (Chen & Yu, 2021). The case firm has repeatedly adapted to changes in the environment by shifting from mechanical to electronics engineering capability, then from Turntables to Compact Disc (CD) technology, then CD to Digital Streaming (DS), and, more recently, to integrated open platforms and space optimization technology enabled by the Industry 4.0, to name a few of the most prominent adaptations to avoid obsolescence.

We present a qualitative, longitudinal study of this SME, which is a medium-sized, mature family firm employing 175 people. It is a major exporter to Europe, Japan, and the US. Since there is generally little published information about SMEs, our case firm is an exception and receives significant media attention in its sector. It is the recipient of several innovation awards including the UK Design Council’s Millenium Product award and the Queen’s Award for Innovation. The firm increased profits in 2020 despite the Covid-19 pandemic, according to its recent podcasts.

We use a single case study as a revelatory case that displays an ambiguous phenomenon in practice (Siggelkow, 2007). Our case firm is revelatory because its unique history and recognized awards offer a fertile foundation for the analyses. The external recognition and prestigious awards make this case firm more visible with high experience levels of the phenomenon under study, as suggested by Pettigrew (1990). Our choice of a mature SME helps us understand the digital transformation journey that evolved over a long period in ways that non-mature SMEs would not give us (Siggelkow, 2007).

Conducting rigorous longitudinal studies demands considerable time and effort to collect and interpret data over a long period (Naldi et al., 2014). Therefore, having access to and long-term relationships with the firm was an important asset. Furthermore, we focused on a technology-intensive manufacturing SME as the rate of change is high in the context of Industry 4.0 (Müller et al., 2018). Indeed, the electronics and audio industry has undergone significant change over the years, driven largely by advancements in digital technologies (Shen et al., 2019). By using a single case study approach, we deal with a certain trade-off between the depth of the analysis of the selected case and the potential generalization of findings. However, we dealt with this issue by adopting a rigorous and high-quality research design based on suggestions by Ketokivi and Choi (2014), Gibbert, Ruigrok, and Wicki (2008), and Gerring (2004).

3.2. Data collection

Primary data collection took place from 2009 to 2020. Qualitative data were obtained through studies of internal and public documents (Ghauri, Gronhaug, & Strange, 2026), a total of 22 semi-structured face-to-face interviews (Bell, Bryman, & Harley, 2019; Alvesson, 2011), discussions, and observations (Churchill & Iacobucci, 2015), particularly involving: Chairman (the founder), CEO, Operations Director, Operations Manager, R&D Director and members of the Operational Delivery Group (see Table 1). The interview questions were designed for inducing lived experiences while using a case study protocol. All interviews were initiated by asking questions covering a broad range of topics, inquiring about the firm history, job roles, current projects, team, client and environmental interactions, changes, and the new product and technology development journey. Transcriptions were undertaken by an external, professional, English-speaking transcriber, using de-naturalistic transcription (Oliver, Serovich, & Mason, 2005). All primary data were uploaded to a database using NVivo 11 Pro software for coding purposes.

Additionally, as presented in Table 1, the authors and the case firm participated in a four-year pan-European Project (2009–2012), which aimed to enhance the competitiveness and adaptability of European SMEs. Thus, the case firm had been subject to interviews, group discussions as well as other project activities, e.g., seminars, face-to-face, and online project meetings, and workshops. During this time, we were involved in observing and reviewing through regular meetings, but not actively involved in executing. Therefore, a longitudinal study rather than action research is considered more favorable.

As the last step of data collection, secondary sources such as the company website (i.e., our story section), archival information, and publicly available written documents from media (e.g., magazine and newspaper articles), as well as recent podcasts about the firm, were collected. For example, we searched the ABI/INFORM database, and 86 magazine articles were analyzed based on abstract and title searches. As a result, 35 magazine articles (from, e.g., Financial Times, Business Wire, and Scottish Business Insider) were selected. We also conducted a web search and identified 10 online newspaper articles (from, e.g., the BBC, The Herald) and four recent podcasts about the firm. Finally, we coded our secondary data files in our NVivo database. This approach allowed us to achieve data triangulation in terms of multiple data sources, closeness to data, and increased depth, reliability, and consistency (Flick, 2018).

3.3. Data analysis

Longitudinal research should preferably be an objective illustration of past events (Street & Ward, 2012). Therefore, time boundaries validity was ensured through a wide observation window that captures all major events. The primary data collection methods went far enough back in the timeline and secondary data were used to enhance our understanding of the firm’s habitus retrospectively.

Data analysis occurred by way of an open coding process using...
Table 1
Primary and secondary data sources.

<table>
<thead>
<tr>
<th>Data sources</th>
<th>Type of data</th>
<th>Use in the data analysis</th>
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<tbody>
<tr>
<td>Semi-structured interviews</td>
<td>22 face-to-face, semi-structured interviews were held between April 2009 and March 2017 with the senior management team as well as the Operational Delivery Group (ODG). The average length for interviews: 90–120 min., resulting in 336 pages of transcripts.</td>
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<td>Top Management Team (TMT): 6 face-to-face interviews with the Founder, and the current CEO.</td>
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<td>Senior Management Team (SMT): 15 onsite, face-to-face interviews with the Operations Director, Purchasing Manager, R&amp;D Manager, and Product Development Manager.</td>
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<tr>
<td>ODG members: 1 group interview with the members of the ODG.</td>
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<tr>
<td>Direct participant observations</td>
<td>Total of 10 days of participant observations in workshops (November 2010 – March 2012); 85 pages of workshop summary report 18s pages of formal reports submitted to the European Commission as part of the project.</td>
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<tr>
<td>Project meetings</td>
<td>Nine face-to-face meetings (a total of 23 days) were held bi-annually (February 2009 – December 2012). The meetings were held off-site and with attendance by at least two senior managers from the firm. Each meeting lasted 2–3 days and observations and discussions were recorded in progress reports and meeting minutes (52 pages reports, 5.65 GB electronic data folder). 24 Online meetings. Average meeting duration: 1 h, 72 pages of meeting minutes.</td>
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<tr>
<td>Internal documents</td>
<td>Interviews, presentations, key performance indicator (KPI) reports/pictures of the visual KPI boards, other strategy documents, research reports.</td>
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<tr>
<td>Public documents/ Podcasts</td>
<td>Interviews, practitioner magazines, newspaper articles, web pages, and secondary research reports. A total of 86 documents were analyzed and the most relevant 45 documents were uploaded to the NVivo database for coding, e.g., Increase validity of single case narrative and coding exercise, create a progressive and in-depth understanding of repeated digitalization efforts. Triangulate primary data with secondary data, and increase understanding of digitalization efforts and outcomes iteratively.</td>
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Table 1 (continued)

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<tr>
<th>Data sources</th>
<th>Type of data</th>
<th>Use in the data analysis</th>
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<tbody>
<tr>
<td>Financial Times, Business Wire, Scottish Business Insider, BBC, The Herald. Total number of pages: 617 pages</td>
<td>data points via secondary data analysis covered a period from 1973 when the firm was set up then enduring both the 2008 global financial crisis, the 2016 Brexit vote, and the Covid-19 pandemic. The podcasts provided data triangulation and validation of the findings.</td>
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<tr>
<td>podcasts covering the period of the Covid-19 pandemic (2019-2020), 205 min.</td>
<td>Totals 22 in-depth interviews/ 336 pages of transcripts; 10 days of participant observations; nine strategy workshops/ 270 pages of summary reports; 23 days of project meetings (52 pages of reports/electronic folder size: 5.65 GB); 24 online meetings/ 72 pages of meeting minutes; 86 published reports &amp; four podcasts (205 min.)/ 617 pages secondary data</td>
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thematic analysis. The thematic analysis offers effective identification of patterns in a large and complex dataset, as well as links within analytical themes (Braun & Clarke, 2006). First, we imported the transcribed interviews and secondary data into NVivo 11 to conduct an iterative series of phases to identify themes. Coding initially focused on the aggregate dimensions, where we used insights from prior literature on DCs. To help us understand how SMEs execute digital transformation, we adopted Nayak et al. (2020) classification of noncognitive aspects of DCs – i.e., empirical sensitivities and habitus.

We then followed a similar process for thematic coding presented by Braun and Clarke (2006) and additional inductive codes were generated to represent the activities in the form of first-order concepts (e.g., marry competencies in the ecosystem). Then, we grouped related first-order concepts into broader thematic second-order codes as sub-themes (e.g., affinity with innovation ecosystem), by which we found that we could distinguish between four themes: for example, strategic selectivity of what you do and do not do, refocus on core competencies to avoid strategic drift, affinity with innovation ecosystem and perennial ethos.

The development of each second-order theme also involved a continuous consultation with relevant literature, so that empirically driven codes could be connected to emerging theoretical concepts. Through a series of iterations, we were able to discover links and patterns within the codes (Table 2).

Table 2
Data structure.

<table>
<thead>
<tr>
<th>First Order Concepts</th>
<th>Second-Order Themes</th>
<th>Aggregate Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Modularity and upgradability for product longevity rather than planned obsolescence</td>
<td>A. PERENNIAL ETHOS (besides predispositions and tendencies)</td>
<td>HABITUS (of the firm)</td>
</tr>
<tr>
<td>A2. Strategic alignment with organizational purpose</td>
<td>B. STRATEGIC SELECTIVITY (of what you do and do not do)</td>
<td>EMPIRICAL SENSITIVITIES (for obsolescence avoidance)</td>
</tr>
<tr>
<td>A3. Grassroots involvement in innovation</td>
<td>B1. Reinforce a single, consistent message to customers</td>
<td>C. (RE)FOCUS (on what matters to the core business to avoid strategic drift)</td>
</tr>
<tr>
<td>A4. Grassroots involvement in innovation</td>
<td>B2. Refrain from core competencies becoming core rigidities</td>
<td>D. AFFINITY with the innovation ecosystem</td>
</tr>
<tr>
<td>A5. Increase visibility of single case narrative and coding exercise, create a progressive and in-depth understanding of repeated digitalization efforts.</td>
<td>C1. Diverge from propriety products and focus on core competencies</td>
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<tr>
<td>A6. Increase visibility of single case narrative and coding exercise, create a progressive and in-depth understanding of repeated digitalization efforts.</td>
<td>C2. Have an integrated business model</td>
<td></td>
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<tr>
<td>A7. Increase visibility of single case narrative and coding exercise, create a progressive and in-depth understanding of repeated digitalization efforts.</td>
<td>D1. Marry competencies in the ecosystem</td>
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<td>A8. Increase visibility of single case narrative and coding exercise, create a progressive and in-depth understanding of repeated digitalization efforts.</td>
<td>D2. Manage loose-tight network relationships</td>
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4. Findings

4.1. The firm’s transformation journey

In the first section of our findings, we explain the most salient historical events (depicting the firm’s habitus) which began in 1973 when the firm was set up and introduced its first product innovation, turntables, that still successfully survive today. The timeline reflects the entire period where the case firm had several adaptations while enduring the 2008 financial crisis, the Brexit vote in 2016, and the recent Covid-19 pandemic (see Fig. 1).

Based on the timeline of key events as presented in Fig. 1, we observed that a key feature of the firm’s history is its rapidly evolving nature. In line with the literature (Verhoef et al., 2021), our case firm went through three phases of digital transformation: phase 1 (digitization) included converting analog information into digital information in order to integrate IT with existing skills, and tasks to manage obsolescence. During the 1980s and early 1990s, the case firm had a shift from mechanical to electronics engineering capability. The development of the Compact Disc (CD) technology began in the 1970s when Sony and Philips were conducting R&D on digital, optical disc technology. Then, CD technology and the digital music revolution started to grow in the 1980s (Coldewey, 2012). Starting in 1991, Phase 2 (digitalization) included building the foundation for obtaining noncognitive capabilities and continuing alignment with the technological changes to avoid obsolescence. In this phase, the firm altered existing business processes, and changed value creation activities by turning its focus from turntables to exploiting CD technology. In this phase, the firm also started exploring digital streaming technology.

Starting in 2006 and with the growth of Industry 4.0 technologies, Phase 3 (digital transformation) focused on efforts to develop important digital skills, and the fusion between the business and technology to avoid obsolescence by company-wide change, executing and revising noncognitive DCs. This phase is still continuing today as the case firm went through three phases of digital transformation: phase 1 (digitization) included converting analog information into digital information in order to integrate IT with existing skills, and tasks to manage obsolescence. During the 1980s and early 1990s, the case firm had a shift from mechanical to electronics engineering capability. The development of the Compact Disc (CD) technology began in the 1970s when Sony and Philips were conducting R&D on digital, optical disc technology. Then, CD technology and the digital music revolution started to grow in the 1980s (Coldewey, 2012). Starting in 1991, Phase 2 (digitalization) included building the foundation for obtaining noncognitive capabilities and continuing alignment with the technological changes to avoid obsolescence. In this phase, the firm altered existing business processes, and changed value creation activities by turning its focus from turntables to exploiting CD technology. In this phase, the firm also started exploring digital streaming technology.

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4.2. The habitus of the firm

To execute successful digital transformation and make timely decisions, all respondents in our study explicitly expressed and alluded to the importance of having a perennial ethos. We observed that crafting such a collective mindset is associated with the firm’s accumulated experiences, predispositions, and shared history. The firm’s ethos is described repeatedly as modularity and upgradability for product longevity, strategic alignment with organizational purpose, and grassroots involvement in innovation. Next, we will expand on what constitutes the firm’s perennial ethos and how they constrain the empirical sensitivities, collectively shaping noncognitive DCs.

4.2.1. Modularity, upgradability, longevity

The founder believes music is a means of communication of emotion among people via time and space. Even from the outset, in 1973, they started by asking whether such communication was being well delivered. Subsequently, the customer value proposition focuses on the notion of high-quality music that can be downloaded at home and streamed at maximum quality through networked, modular, and upgradable products. This ethos enabled the firm to achieve integration capability and avoid planned or unplanned obsolescence in the context of technological turbulence accelerated by Industry 4.0.

Driven by a deep understanding of the uneven pace of technology trajectories, the company ethos was future-proofing itself and continuously upgrading its products to avoid obsolescence. One manager explained that:

So conceptually, at the beginning in our architecture, we split the player, server, and controller and that was a crucial decision that would allow progress to occur on any one of those things independently. Over the past years, each of these things has progressed in completely independent ways. Servers get better. They get better at a different rate of change than a player. And controls have got better and they get better at a different rate of change to players and servers. So, our products launched — our first intelligent connected players – in 2007. But the iPad came along in 2010. Six months later it was the Number One choice for our customer to control their systems with. If we made it a proprietary system then we would not have been able to ride that wave of the iPad (Interviews, 2016).

Being able to pursue such an ethos is also influenced by the firm’s characteristics. For example, since they are an independent family
business, they do not have any external shareholders forcing them to make short-term decisions. The management team believes in quality and longevity, not planned obsolescence. They highlight in the interviews and podcasts that the firm is driven by business sustainability and pride, not only by profit. Therefore, they concentrate on satisfying their customers through high-quality music through the design and development of modular, compatible, and upgradable systems. The following statement by a Senior Manager illustrates this point:

We didn’t want to make CD players. We didn’t think CD was good enough, because it didn’t sound as good as vinyl and it never has done, and also because the CD engine, the platform of CD, was not upgradeable. Not modular, not upgradeable. So, it’s an industry that kind of killed itself, unfortunately (Interviews, 2015).

4.2.2. Alignment with organizational purpose

Our analysis reveals that the overall purpose of the firm stood the test of time, better music performance, and the focused, integrated business model facilitated the transformations that had to be made to avoid becoming obsolete. However, for a period in the past, they could not avoid a strategic drift and had a TV distribution business and an OEM contract with a luxury carmaker that looked to be making good turnover but, the profitability was marginal. Initially, the two firms were very aligned in terms of their core values; however, their customer was taken over by another large automotive company and the new owner did not value their suppliers’ IP and continuously asked for price reductions. As a result, they lost those two businesses at the same time as there was a misalignment between their organizational values. At that time, the case firm was overly diversified before it decided to strategically refocus on its core organizational purpose. As the CEO highlighted ‘we had spread ourselves too wide...We had started to do things that were not our prime purpose’ (Interviews, 2017).

Thus, we identified that strategic alignment with the organizational purpose was an important ethos when making trade-off decisions. Yet, this ethos evolved following lived experiences, failures, and the lessons learned from the aforementioned organizational breakdowns, which also collectively shape the firm’s habitus.

4.2.3. Grassroots involvement in innovation

A relentless pursuit of innovation to avoid obsolescence has been a key pillar of the firm’s ethos, as the CEO emphasized on several occasions during his talks, ‘...the best way to protect your technology is to keep innovating’. He emphasized that their firm is one of those small companies that is continually making new products. They need to do this because it is highly likely that their products and technology will get copied and there is nothing they can do about it, other than to keep innovating. To keep ahead of the competition, they identify innovation as the best possible protection they have.

Interestingly, a longitudinal analysis of the case firm revealed that avoiding obsolescence is determined by the ability of senior managers to decipher the right action when threats emerge, thereby creating a crossroads of options in the transformation journey. The CEO has an electronics engineering, telecoms, and IT background and worked for a manufacturing SMEs execute digital transformations to avoid obsolescence?

We uncovered three primary categories of empirical sensitivities underpinning the firm’s noncognitive DCs to avoid obsolescence (Table 3): strategic selectivity, (re)focus, and affinity with the innovation ecosystem. In order to make obsolescence obsolete, the firm developed capabilities to be highly selective about what they do and do not do. The strategic selectivity capability enables the firm to direct its limited resources as an SME to the key areas of the business. Then, they develop a second foundational capability to focus on what matters most for the business. The ability to have a focused strategy and business model enables the firm to control obsolescence and become highly adaptive. Once they apply strategic selectivity and focus capability to avoid strategic drift and core rigidities, they develop the capability to establish ecosystem partnerships, engage with the community, and platform, and manage integration. The firm manages ecosystem partnerships with the aim to marry competencies in the ecosystem. This approach is highly useful particularly in an SME context as they have limited resources (Ates, Garengo, Cocca, & Bititci, 2013). We have presented our findings through case vignettes and example quotes from the interviews in Table 3.

In summary, our empirical findings show that the aforementioned three empirical sensitivities reinforce each other and coevolve over multiple practices through the firm, cumulatively generating the firm’s habitus while making the firm and its actors capable of executing timely digital transformation to avoid obsolescence.

5. Discussion

Our study addresses a gap in the literature for more longitudinal and qualitative studies to understand the tacit mechanisms underpinning successful digital transformations and related noncognitive DCs to prevent obsolescence in the context of SMEs (Del Giudice et al., 2021; Papa et al., 2020; Smith & Beretta, 2020; Jain, 2016; Naldi et al., 2014; Chia & MacKay, 2007). In doing so, we seek answers to: how do high-tech manufacturing SMEs execute digital transformations to avoid obsolescence? what are the associated noncognitive dynamic capabilities?

Our case firm’s digital transformation journey is still continuing today, but tracking it through the three phases of transformation – digitization, digitalization and digital transformation (Verhoef et al., 2021) provides us with useful insight to understand how SMEs execute digital transformation. We argue that a better understanding of the link between noncognitive DCs, obsolescence, and digital transformation would be of substantial value to bridge the gap between theory and practice.

In response to our research questions, we identified that SMEs engage with two key motives. First, company-wide, empirical sensitivities and the habitus of the firm have created a foundation for an SME to move through different phases of digital transformation. In terms of digital technology, this is manifested in the exploration and exploitation
Table 3 (continued)

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<th>Empirical sensitivities</th>
<th>Case vignettes</th>
<th>Example quotes from the interviews</th>
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<td>AFFINITY WITH THE INNOVATION ECOSYSTEM</td>
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<td>Description: This capability is focused on the community, platform, and integration. It incorporates managing network relationships and marrying competencies in the ecosystem.</td>
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<td>“That’s Spotify saying, ’We’re going to force you to use our UI,’ and that’s the fear-based version of what we were talking about earlier. Now, look what’s happened. TIDAL has been bought by Jay-Z, just a few weeks ago, and it streams CD quality. Spotify only does MPS, so it’s coming in at a higher quality, and guess what? It took us six weeks from speaking to TIDAL, from getting the source code, to building it into our ecosystem, because they’re totally open” (Interviews, 2015).</td>
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<td>as well as make large savings in propriety license fees. The capabilities of the firm were expanded further through the development of core expertise in operating software that would previously have been resident in proprietary, outsourced subsystems. The procurement processes were transformed since the firm was buying more raw materials and fewer subsystems. Although the firm incurred relatively more development costs, they were reducing overall product costs, thus improving price versus performance value for their customers.</td>
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of digital streaming technology and the use of Industry 4.0 technologies on which collaborative and innovative digital solutions are developed and quickly deployed at the ecosystem level. Fig. 1 shows the timeline, exploration, and exploitation events. Second, in terms of business, noncognitive DCs are manifested in the concurrent but mutually reinforcing efforts to drive the existing business via repositioning, learning from organizational breakdowns, and exploration of new growth opportunities. In doing so, we observed a conscious shift towards the exploration of new possibilities to counter the obsolescence trap (Fig. 1).

Importantly, this shift includes the development of new noncognitive capabilities for ‘search, refinement, selection, re-focus, and ecosystem connectivity’ on the one hand, and ‘modularity, strategic alignment, grassroots involvement in innovation, flexibility, and upgradability’ on the other. As such, there is a mutual influence between empirical sensitivity and the habitus of the firm (i.e., empirical sensitivity generates habitus, and habitus constrains empirical sensitivity). This observation is consistent with current literature where reciprocal interactions between empirical sensitivities and habitus have been conceptually discussed before (e.g., Nayak et al., 2020; Bruineberg & Rietveld, 2014). Building on these previous conceptualizations, we have provided answers to our second research question and extended theory by identifying three specific empirical sensitivities along with six related strategic activities as well as the components of habitus that underpin noncognitive DCs, required in digitally transformed SMEs (See Table 2 and Fig. 2).

The insights derived from our case study support the conceptual framework in Fig. 2 in unpacking the logic of noncognitive DCs development in a digitally transformed SME. We argue that the greater the extent of noncognitive DCs an SME can develop while moving through the digital transformation phases, the more alert it will become to counter an obsolescence trap. The more continuous the business-digital technology fusion an SME can achieve, the more it is able to adapt. Therefore, we argue that the relationships between noncognitive DCs, digital transformation, and obsolescence trap avoidance are not sequential or path-dependent but more dynamic and interactive. Our findings empirically support earlier findings (e.g. Nayak et al., 2020; Bruineberg & Rietveld, 2014) that there is a double sense arrow between empirical sensitivities and habitus due to the reciprocal interactions between them.

Consequently, an additional level of complexity in digital transformation comes from the fusion between business and digital technology. When business and technologies are effortlessly integrated through underpinning noncognitive DCs, firms become more skilled at countering an obsolescence trap. Hence, mere digital technology alignment is insufficient to avert obsolescence demanded in the digital age and SME managers should pay attention to broader social and organizational issues (Heavin & Power, 2018).

5.1. Theoretical contributions

We consider three primary areas, where our study has theoretical implications. First, we bring conceptual clarity to how obsolescence, noncognitive DCs, and digital transformation are linked which helps us bridge the gap between theory and SME practice. Our conceptual framework (Fig. 2) outlines the level of complexity for SME digital transformation efforts to counter obsolescence. We contribute to the call for research by Naldi et al. (2014) and Peteraf et al. (2013) regarding more integrative investigations into the tacit nature of DCs by revealing three important empirical sensitivities (strategic selectivity, re-focus, and ecosystem connectivity - a finely honed observation capacity to changing environmental conditions and the corresponding development of a set of generic coping skills) for the execution of the digital transformation. Cumulatively, the three empirical sensitivities we identified in our study generate the habitus and noncognitive capability through which the key aspects of sustained competitiveness are realized.

Second, throughout our fieldwork, we found that explaining DCs through replicable best practices, or analytical, linear, and stepwise processes was not possible (Tecece, 2007). Instead, we found that habitus (e.g., internal responsiveness nurtured through the collective complex history of an SME—its tacitly acquired/transmitted outlooks, social predispositions, ethos, and internalized practices) affects how firm sensitivities materialize into ongoing adaptations. Indeed, digital transformations are executed through the firm’s habitus reflecting its unique collective history including lessons learned from organizational breakdowns and experiences (Nayak et al., 2020; Habersang, Kueberling-Jost, Reihlen, & Seckler, 2019; Jarzabkowski, L¨aheimonen, & Pihkala, 2019). In the past, such strategic drift and excessive diversification resulted in failure traps (Gupta, Smith, & Shalley, 2006) for our case firm. For instance, the firm went into a period of uncontrolled growth and diversification. This failure trap was overcome quickly by refocusing on organizational values and perennial ethos and, consequently, an intended shift to digitalization. Therefore, we found that perennial ethos together with predispositions and tendencies collectively shape the firm’s habitus while crafting a collective and shared purpose (Peter et al., 2020; Sievinen, ¨Ikk¨aime¨onen, & Pihkala, 2019; Heavin & Power, 2018; Malhotra, 2005).

Third, unlike other studies, where obsolescence is recognized but identified as a risk (Agarwal & Helfst, 2009; Rojo et al., 2009), or a problem (Chen & Yu, 2021), our findings importantly show that it has become a fundamental organizational trap in a technology-driven environment that needs careful management. The most important strategic implication is that risk assessment changes dramatically,
presenting, as aforementioned, a new set of technological dependencies that can derail a firm’s best efforts to manage obsolescence more strategically. For example, in the DS product architecture, servers, controllers, and players have all progressed in completely independent ways within the ecosystem. Driven by a deep understanding of the uneven pace of technology trajectories (Chung et al., 2012) coupled with the ethos of future-proofing, modularity and upgradability helped our case firm avoid an obsolescence trap. Therefore, our study suggests that controlling obsolescence is key to successful and timely digital transformations in the context of rapid competitive shifts (Day & Schoemaker, 2016), and uneven technology transitions (Knott & Posen, 2009). Making timely, proactive decisions regarding the adoption of DS, IoT, and Cloud technologies (Shen et al., 2019) prevented our case firm from becoming trapped in obsolescence.

Overall, our study offers important contributions by identifying a theoretical construct, obsolescence trap – failure to foresee and manage uneven technological advancements affecting products and services within ecosystems, which has become highly relevant to today’s digital age. We suggest that the reciprocal interactions between high-tech SMEs’ habits and empirical sensitivities include careful management of obsolescence trap avoidance, which is an indispensable part of the timely and successful execution of digital transformations.

5.2. Managerial implications

From a practical point of view, our study supports SME managers in the likelihood of successfully implementing digital transformations to remain relevant and viable in the ecosystem. We have developed an actionable framework that SMEs can use to effectively manage obsolescence. The management literature shows that, although technological change can provide remarkable opportunities, it can also lead firms to have organizational breakdowns (Habersang et al., 2019; Jarzabkowski et al., 2019) caused by strategic drift (Handy, 1989) or obsolescence (Amankwah-Amoah, 2017; Cooper, 2004) or competency and failure traps (Gupta et al., 2006; Levitt & March, 1988). Inevitably, those firms unable to change become trapped and can lose their competitiveness. To make obsolescence obsolete, our study offers the following recommendations for high-tech, manufacturing SME managers.

First, we found that pursuing innovation relentlessly is effective to restrain obsolescence (Chen & Yu, 2021; Habersang et al., 2019; Jain, 2016). This is particularly relevant in an SME context as they may not have the resources to patent their new technology and products. As a result, they can easily be imitated by rivals (Chen & Yu, 2021) or become trapped in obsolescence. Instead, high-tech SME managers should keep innovating and move to the next competitive position, which is the best possible protection to stay viable and relevant.

To remain viable in dynamic environments, SMEs should develop capabilities for the introduction of timely new products and technologies as the existing ones become rapidly obsolete. In salient contrast to our results, Chen and Yu (2021) contend that, for SMEs to become viable, there is a need for implementing exploitation-focused innovations only and larger firms should pursue exploratory innovations to avoid obsolescence. Another study by Popa et al. (2021) proposes that incremental and exploitative innovation strategies are more common in highly innovative manufacturing SMEs. Our findings suggest contrasting views as our longitudinal analysis has revealed that the relentless pursuit of bold and exploratory innovations has been the underlying factor for long-term competitiveness in high-tech SMEs. Exploration of new technologies, processes, capabilities, and products has been a key capability for the success of our case firm. In this view, Chen and Yu (2021) falsify their initial hypotheses and agree that the negative impact of exploratory innovation on obsolescence is not stronger in large firms than in SMEs.

Second, our findings suggest that innovation capability should be configured according to the innovation ecosystem (Del Giudice et al., 2021) due to technological dependencies. Hence, we need ecosystem thinking to prevent obsolescence collectively (Del Giudice et al., 2021; Papa et al., 2020; Peter et al., 2020; Jiao, Yang, Zhou, & Li, 2019). Hence, our analysis shows the increasing salience of ecosystem participatory innovation in the new digital age and aligns with existing research on innovation ecosystem relationships (Jiao et al., 2019; Kapoor, 2018; Tsee & Linden, 2017; Weill & Woerner, 2015; Adner, 2006).

Third, we found that successful digital transformations cannot be associated with a unique cause such as innovation capability but, rather, a series of empirical sensitivities (Popa et al., 2021). For example, due to the high dependencies in the innovation ecosystem, it is important to have heightened selectivity and focus on SMEs’ activities and the selection of ecosystem partners. Effective management of obsolescence increasingly comes from effective partnerships within the ecosystem (Jiao et al., 2019). Interestingly, our data indicate that the starting point is developing a clear, emotionally engaging organizational core purpose and perennial ethos that provide a strategic anchor from which senior teams can balance the contrasting requirements of environmental opportunities (Peter et al., 2020; Heavin & Power, 2018; Eichholz, 2017; Malhotra, 2005). A distinctive focus on a higher organizational purpose brings consistency and commitment-based relationships to the ecosystem (Del Giudice et al., 2021; Malhotra, 2005). Research commonly suggests that forming collaborative relationships with various partners with a complementary set of capabilities is desirable in the innovation ecosystem (Adner, 2006). However, our results highlight that formation of productive partnerships is more complex. Importantly, we suggest that SME managers should seek strategic alignment with organizational purpose and perennial ethos when selecting partners in the ecosystem.

5.3. Limitations and future research

As with all research, the current study is not without its limitations. First, our study is focused on understanding noncognitive DCs underpinning effective management of digital transformations to inhibit obsolescence. However, there is a growing body of literature linking knowledge management and tacit aspects of DCs (e.g., Papa et al., 2020; Santoro, Thrassou, Bresciani, & Del Giudice, 2019; Alegre, Sengupta, & Lapiedra, 2003). Therefore, we call for future research exploring how knowledge management can boost the development of noncognitive DCs to prevent obsolescence.

Second, we focussed on an independent, mature and medium-sized family business, thus the senior management team does not feel immediate pressure from external shareholders for short-term decisions and profitability. This means that the findings could vary in other SME contexts, thus encouraging future academic exploration to delve further into the nuances of the underlying microfoundations of digital transformation to avoid obsolescence in SMEs (Papa et al., 2020). To move this agenda, we suggest large-scale quantitative studies that operationalize our framework in different contexts. For example, we discovered that affinity with the innovation ecosystem is one of the key empirical sensitivities underpinning noncognitive DCs. Future studies could explore other empirical sensitivities and whether affinity with the innovation ecosystem takes place in a global or local setting.

The selected case firm is intrinsically an interesting one to examine in-depth as we have done here, however focusing on a very innovative, award-winning UK-based SME might induce a selection bias impeding the generalizability of findings. By using a single case approach, we deal with a certain trade-off between the depth of the analysis of the selected case firm and the potential statistical generalization of findings (Lee, 1989). This issue, however, does not underestimate the quality of the methodological approach followed in the paper (Keroki & Choi, 2014; Robson, 2002) and does not reduce analytical or theoretical generalization.

Third, although our case study context was digital transformation, our findings may apply to other types of transformation processes and
this would offer a fertile area for future research. For example, our study supports the earlier research findings on the need to implement new leadership methods for successful digital transformations to manage obsolescence (Peter et al., 2020). Thus, further studies are needed to explain the temporal role of reversed (upside-down) organizational forms where openness and psychological safety are offered to employees for participation to improve the execution of transformation processes (Garvin, Edmondson, & Gino, 2008; Warrington, 1974). We believe the concept of an upside-down organization is an interesting area of future research, which can be investigated from the open strategy lens (Chesbrough & Appleyard, 2007). Establishing an upside-down organization where localized decision-making takes place may extend our understanding of capabilities to manage obsolescence.

Finally, our data are mainly derived from the perspective of senior managers and a lack of cross-checking with lower-level employees brings some limitations and impedes the generalizability of findings. Lastly, to advance the work on digital transformation (Shen et al., 2019) that is prone to competency and failure traps (Gupta et al., 2006; Levitt & March, 1988), future research could further unpack the obsolescence trap concept in a technology-driven environment to distinguish it from risk management (Agarwal & Helfat, 2009).

6. Conclusions

In conclusion, making obsolescence obsolete has become, increasingly, a key organizational capability for SMEs in a technology-driven environment to stay viable. The current state of literature linking obsolescence, digital transformation, and DCs calls for extended research (Del Giudice et al., 2021; Papa et al., 2020; Smith & Beretta, 2020; Jain, 2016; Naldi et al., 2014). Most studies adopt Teece (2007) DCs framework of ‘sensing-seizing-transforming’ to examine digital transformations (e.g., Vial, 2019; Warner & Wäger, 2019; Naldi et al., 2014). Our study is different and original as it is focused on clarifying the noncognitive aspects of DCs to make obsolescence obsolete.

To add granularity to recent theorization, we conducted a bottom-up analysis consisting of a qualitative and longitudinal analysis of a carefully selected high-tech SME in the UK. We argue that noncognitive aspects of DCs such as empirical sensitivities and habitus of the firm often emerge and materialize into adaptive actions through perennial ethos, experiences, predispositions, and tendencies (Nayak et al., 2020; Bruineberg & Rietveld, 2014). Habitus comprises the repository of cumulative practices that have proved successful or unsuccessful over time and is unique to a particular firm. Therefore, our analysis reveals that avoiding obsolescence traps, organizational breakdowns (Habersang et al., 2019; Jarzabkowski et al., 2019) and unintended consequences in transformation journeys consists of having a heightened strategic selectivity and focus, which are indispensable and support grassroots involvement in innovation (Chen & Yu, 2021; Habersang et al., 2019; Jain, 2016; Warrington, 1974) and the innovation ecosystem (Del Giudice et al., 2021; Papa et al., 2020; Peter et al., 2020; Jiao et al., 2019).

Further, we offer a conceptual model to explain the interplay of these empirical sensitivities and habitus, that collectively shape the noncognitive DCs, in the context of digital transformation in SMEs. Finally, continued study of making obsolescence obsolete capability in firms operating in technology-driven environments will serve to improve our understanding of firm survival and viability in a world with unprecedented change.

CRediT authorship contribution statement

Aylin Ates: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. Nurcan Acur: Writing – review & editing, Visualization, Resources, Methodology, Investigation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References


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