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Managing technological obsolescence in a digitally transformed SME

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Abstract. We seek to enrich the literature by investigating the digitalization journey of a high-tech, manufacturing small and medium-sized enterprise (SME) to shed light on the topic. We undertook an interpretive longitudinal study between 2009 and 2020, capturing the transformation journey of an award-winning high-tech SME that is designing and manufacturing high-end home entertainment systems including digital streaming products, music players, and speakers. This study offers important contributions to theory and practice. We conceptualize and define the link between technological 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 digital transformation in SMEs. In addition, our study has important implications for practice. SME managers should pay attention to developing non-cognitive dynamic capabilities to effectively respond to digitalization trends by orienting their employees toward careful management of technology obsolescence in a manner unique to the firm's history and experiences.

Keywords: Dynamic Capabilities, Small and Medium-Sized Enterprises-SME, Obsolescence Management, Consumer Electronics, Digitalization.

1 Introduction

There are several technological dependencies in complex products as firms increasingly work with various partners in the ecosystem. Moreover, 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 [10]. Obsolescence arises when a new service, product, or technology replaces an older one [13] such as the introduction of digital music downloads, which replaced compact discs (CDs) [3]. Obsolescence hinders a firm's ability to adapt to the unprecedented changes in the

environment, which may lead to deteriorating performance and viability [7, 14] and makes firms slowly lose dynamic capabilities due to the obsolescence of technologies and knowledge [7, 25]. As such, the capacity to manage technological obsolescence 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.

We seek to enrich the literature by investigating the digitalization journey of a high-tech, manufacturing small and medium-sized enterprise (SME) to shed light on the topic. Our research question is: *How do high-tech manufacturing SMEs execute digital transformations to avoid technological obsolescence?* To address these issues, we develop a framework for managing technological obsolescence in the context of digital transformation.

We proceed by first exploring the relevant literature. We then provide an overview of our case study and qualitative methods before presenting our empirical findings structured as a conceptual model that illustrates the management of obsolescence in SMEs. We then discuss our conceptual model and implications for theory and practice.

2 Literature Review

2.1 Technology Obsolescence

The rapid technology changes coupled with short product life cycles create both challenges and opportunities for organizations [19]. Advances in technology lead to obsolescence in older versions of the products. Product obsolescence usually occurs due to technological obsolescence [3, 19] caused by customers being attracted to newer functions in products. Moreover, some parts incorporated in particularly electronics products have their own life cycles, which must be taken into account when examining technology obsolescence [5]. These electronic parts may have a shorter lifespan than the product they support [4]. Therefore, due to technological products getting more complex and modular, it is essential to think about the system holistically to manage obsolescence [9].

Many authors have come up with different methods and tools to manage obsolescence that unfolds over time. For example, Hurst [12] explains that during the renewal cycle, managers can not directly manage change. They can only manage the organization's ability to change that is to prevent obsolescence. Besides, Rojo et al. [20] point out that planning and managing the firm responses are the only ways to mitigate the risk and minimize the impact of obsolescence. So, it is necessary for organizations to have processes and capabilities to manage obsolescence proactively [18]. As Adetunji et al. (2018) [1,] pointed out obsolescence is here to stay as digitalization and techno-

logical turbulence continue to rise. Therefore, it is important to develop necessary organizational capabilities to manage the risk of obsolescence [2, 23, 24].

2.2 Dynamic Capabilities Perspective

To appreciate the firm-environment nexus and explain how firms execute digital transformation, we focus on dynamic capabilities theory [22]. Teece and his colleagues define dynamic capabilities as 'the firm's ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments [22: p. 516]. In fact, dynamic capabilities are said to allow better decision-making in an environment that is volatile but attractive [15].

Recent research by Nayak et al. [17, p.284] suggests that it is important to go beyond the concepts of analytical best practices and routines [11] and focus on 'a firm's collectively shared, historically shaped practices and predispositions' to understand tacit, noncognitive aspects of dynamic capabilities. Hence, they suggest that 'empirical sensitivity' and 'habitus' are the two key concepts to study the underpinnings of tacit dynamic capabilities [17, p. 288]. Nayak et al. [17, p. 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.' They suggest that we need to investigate firms' empirical sensitivities that reflect its distinctive collective history and experiences in order to explain noncognitive aspects of dynamic capabilities.

Consequently, our theoretical approach goes beyond best practices and reflects how dynamic capabilities needed to manage the digital transformation to avoid obsolescence originate from the accumulation of everyday actions [8].

3 Methodology

This study is based on deep collaboration with a UK-based high-tech SME that manufactures high-end home entertainment and music systems. Our case study's history is characterized by multiple efforts at major digital transformations. Conducting rigorous longitudinal studies demands considerable time and effort to collect and interpret data over a long period of time. Therefore, having access to and long-term relationships with the firm was an important asset. Besides, we focused on a technology-intensive manufacturing SME as the rate of change is high in the context of Industry 4.0 [16]. Indeed, the electronics and audio industry has undergone significant change over the past years, driven largely by the advancements in digital technologies [21].

Qualitative data were obtained through studies of internal and public documents, a total of 22 semi-structured face-to-face interviews, discussions, and observations. 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. All primary and secondary data were uploaded to a database using NVivo 11 Pro software for coding purposes.

Data analysis occurred by way of an open coding process using thematic analysis. The thematic analysis offers effective identification of patterns in a large and complex dataset, as well as links within analytical themes (Braun and Clarke, 2006).

4 Findings and Discussions

We found that the high-tech SME went through three phases of digital transformation (See Fig.1.): phase 1 in converting analog to digital technology in order to tighten IT alignment with obsolescence, phase 2 in building the foundation for both obtaining non-cognitive capabilities and continuing alignment to avoid technological obsolescence, and phase 3 infusing business and technology to avoid obsolescence by company-wide change, implementing and constantly revising non-cognitive dynamic capabilities [17].

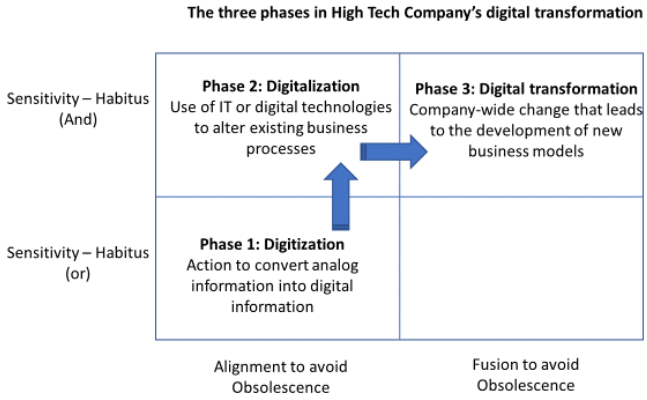

Fig. 1. The conceptual model

This high-tech SME's digital transformation journey is still continuing today but tracking it through the different phases of transformation shows us an insight into how non-cognitive capabilities development help to counter obsolescence. Two key non-cognitive capabilities motives stand out: First, enterprise-wide, empirical sensitivities and habitus of the firm have created the foundation for an enterprise to move through different phases of digital transformation.

In terms of digital technology, this is manifested in a technology development exploration and exploitation activity. This comprises the operational pillar where explo-

ration and exploitation of digital streaming technology and the use of Industry 4.0 technologies are developed and deployed at the ecosystem level. In terms of business, non-cognitive capabilities are manifested in the concurrent but mutually reinforcing efforts within each digital transformation phase to drive the exploitation of existing business via repositioning and exploration of new growth opportunities.

We realize a conscious shift toward the exploitation of technological and environmental certainties to counter the competence or failure trap and the exploration of new possibilities to counter the obsolescence trap. These include the development of new non-cognitive capabilities for "search, refinement, selection, re-focus, network connectivity," on the one hand, and "variation, modularity, strategic alignment, grassroots involvement in innovation, flexibility, upgradability'' on the other hand. 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). The observation is consistent with current literature that highlights reciprocal interactions between empirical sensitivities and habitus that have been conceptually discussed before [e.g., 6, 17]. These qualities, which often complement one another, are fundamental indicators of the challenging demands for SMEs.

The second motive of a digitally transformed SME to avoid the obsolescence trap is to bridge the hidden split between the social side of business and technology. This statement is, again, in line with current practitioner literature that searches to evaluate the digital transformation corresponding to tightening IT alignment with business or reorganization around business capabilities (i.e., sensing, seizing, and transforming) [22, 24]. The treatment is often a development to a higher level of digital superiority (e.g., from an IT alignment to becoming a digital leader) via the development of dynamic capabilities. But what is stimulating with the case of our high-tech SME is the extent of penetration required in business-digital technology integration at the ecosystem level.

4.1 Conceptualizing "Obsolescence"

The insights derived from the transformation journey of our high-tech SME company support the conceptual framework in Figure 1 in unpacking the non-cognitive dynamic capabilities development logic of a digitally transformed SME. The greater the extent of non-cognitive capabilities namely environmental sensitivity and habitus that an SME can develop in moving digital transformation phases, the more alert it will be in adapting to counter obsolescence trap. The more continuous the business-digital technology fusion SME can achieve, the more it is able to adjust digital ubiquitously to counter obsolescence in all aspects of its business.

The ideal level of non-cognitive capabilities and business-digital technology fusion may differ in different digital transformation phases. For example, in a less complex environment, or in an industry that has less competition a lesser degree of IT align-

ment or business-digital technology fusion may suffice to avert technological obsolescence. Most digital transformations are likely to be at the first phase of the digital transformation process, largely taking efforts focusing on environmental sensitivity to reposition existing businesses or habitus to seek new growth opportunities, with strong support from digital technology. The second and third phase of digital transformation tends to be more pervasive in driving both environmental sensitivity (e.g., select, refocus processing-acquired intelligence - a finely honed attunement to environmental solicitations and the discernment of obsolescence) and habitus (e.g., internal responsiveness nurtured through the collective complex history of an SME—its tacitly acquired/transmitted outlooks, social predispositions, and internalized practices). An additional level of complexity in digital transformation comes from the fusion between business and digital technology—that is, such sensitivity and habitus efforts are motivated by Industry 4.0 technologies where business and technologies are effortlessly integrated. The fusion provides a greater skill to counter the technology obsolescence trap. Mere digital technology alignment is insufficient to avert obsolescence demanded in the digital future.

5 Conclusions

Based on the findings from the review of literature and empirical research, we presented the relationships between the key theoretical constructs emerging from our study in a model for digital transformation in Figure 1. As with all research, the current study is not without its limitations. First, the conceptual clarity of obsolescence, non-cognitive capabilities, and digital transformation link consequently help to bridge the gap between academic research and what SMEs are doing. Practitioners' understanding of the term digitally transformed enterprise can thus be linked conceptually to the research. The 2 × 2 matrix (as shown in Figure 1) also provides a way to outline conceptually the level of complexity for different digital transformation phases' efforts to counter obsolescence.

In conclusion, making obsolescence obsolete has become increasingly a key organizational capability for SMEs in a technology-driven environment to stay viable. We offer a novel conceptual framework 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 rapid and unprecedented change.

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