Exploring Information Technology Capabilities from Multiple Aspects of the Resource-Based Theory

Abstract

This study elucidates the nature of information technology (IT) capabilities by developing an integrated framework that expounds upon the hierarchy inherent within IT capabilities. This research uses qualitative interviews with 64 IT professionals grounded in the resource-based theory to delineate three layers of IT capabilities. At the foundational level, IT capabilities reflect firms' IT-related assets, encompassing IT infrastructure, informational, and enabled assets that are valuable, rare, and inimitable. Higher up, firms' IT capabilities manifest through competence in organising these IT-related assets effectively. *Operational IT competence* is instrumental in mobilising and deploying each IT-related asset, while *dynamic IT capabilities* represent firms' capacity to reconfigure and assimilate various operational IT competencies. This research contributes to the field by providing an integrative theoretical understanding of how IT capabilities are formed. The proposed model addresses fragmentation in the existing literature, facilitating the development of more cohesive, evidence-based strategies for generating business value from IT.

Keywords: Information technology capabilities; Resource-based theory; IT infrastructure; IT investment, Organisational capabilities; Dynamic capabilities

1. Introduction

In recent decades, steady advancements in information technology (IT) have made IT infrastructure and solutions increasingly affordable and accessible to businesses across all industries and sizes (e.g., Dang-Van *et al.*, 2024; Huber *et al.*, 2022). A Gartner Report (2018) confirms this trend and suggests that, over the next three years, most chief information officers' primary strategic objectives will likely be to enhance cost efficiency, drive business value, and improve productivity. Specifically, the report predicts the possibility of 5–15% reductions in overall IT budgets as firms aim to maximise returns on their technology investments. One critical factor that determines whether firms can fully leverage such investments to realise the anticipated benefits is their "IT capabilities" (e.g., Melville, Kraemer, & Gurbaxani, 2004; Mukhopadhyay, Kekre, & Kalathur, 1995; Santhanam & Hartono, 2003). While definitions may exhibit some variability, IT capabilities are generally understood to encompass firms' proficiency in effectively deriving business value from IT. Firms with IT capabilities can gain significant strategic benefits, from reduced costs to improved agility, market responsiveness, and innovative offerings. Both academics and practitioners have exhibited renewed interest in understanding the mechanisms through which robust IT capabilities can confer competitive advantages and enable positive business outcomes (e.g., Chae, Koh, & Prybutok, 2014; Li & Chan, 2019; Mao, Liu, Zhang, Zhang, & Gong, 2021).

Despite the widely acknowledged strategic importance of IT capabilities (Majhi *et al.*, 2022), a close examination of the extant literature reveals that discussions of IT capabilities remain fragmented across different research domains. To offer some illustrations, Melville *et al.* (2004) posit that IT capabilities can be conceptualised as the integration of technological IT resources and human IT resources. Ravichandran and Lertwongsatien (2005) evaluate IT capabilities as the amalgamation of firms' system development capability, information system support maturity, information system operation capability, and information system planning

sophistication. Zhang, Sarker, and Sarker (2013) propose a model wherein IT capabilities encompass six dimensions: IT–business partnerships, external IT linkages, business IT strategic thinking, IT business process integration, IT management, and IT infrastructure. This conceptual complexity and fragmentation has impeded the emergence of a cohesive integrative theoretical perspective on how IT capabilities are formed, leveraged, and translated into competitive advantages.

To address this gap, this research delves into the nature of IT capabilities through the lens of the resource-based theory (RBT), which posits that valuable resources drive competitive advantages (Barney, 2001; Barney, Ketchen, & Wright, 2011; Barney, Wright, & Ketchen, 2001). The RBT offers a relevant perspective, as many studies have used it to examine IT business value (e.g., Bharadwaj, 2000; Lai, Li, Wang, & Zhao, 2008; Lioukas, Reuer, & Zollo, 2016), but its conceptual breadth, while a strength, also contributes to fragmentation (e.g., Huber *et al.,* 2022). Specifically, when applying the RBT, researchers categorise many tangible and intangible IT elements as "resources", highlighting the complex nature of IT capabilities but inhibiting integrative understanding (e.g., Dang-Van *et al.,* 2024). Therefore, further research grounded in the RBT is needed to consolidate knowledge and transcend disciplinary boundaries. A cohesive evidence-based perspective, which elucidates the connections between different IT capability conceptualisations, will facilitate more systematic guidance for practitioners on strategically developing and leveraging these capabilities in contemporary organisational contexts (Majhi *et al.*, 2022). Accordingly, our in-depth qualitative study, involving 64 interviews with IT professionals, aims to delineate a unified framework for understanding IT capabilities. By exploring professionals' perspectives on defining, cultivating, and translating IT capabilities into competitive advantages, this research clarifies the relationships between distinct conceptualisations and provides practitioners with actionable principles for strengthening IT strategic alignment.

More specifically, our analysis demonstrates that firms' ownership of foundational IT-related assets, including IT infrastructure, IT informational, and IT-enabled assets, serves as a critical indicator of IT capabilities, enabling a substantial enhancement of organisational agility. However, possessing diverse IT-related assets may not be adequate to bestow firms with sustainable enhancement. Firms must develop operational IT competence to fully realise the potential inherent in these assets. This operational IT competence is crucial in strategically organising and mobilising each IT-related asset. Our research identifies distinct operational IT competence —IT infrastructure, IT informational, and IT-enabled competence—crucial for proficiently deploying each IT-related asset. As a result, firms with IT capabilities do not simply acquire a wide range of IT-related assets, but also use them effectively and organise them strategically to maximise their effectiveness. Finally, our analysis emphasises dynamic IT capabilities, reflecting firms' capacity to reconfigure and assimilate three sets of operational IT competence. These are the dynamic IT opportunities-sensing capability, the dynamic IT opportunities-seizing capability, and the dynamic IT business transformation capability. These dynamic IT capabilities allow firms to reconfigure their operational IT competence, enabling them to navigate dynamic environments, innovate, and sustain over the long term. Together, this multilayered perspective provides a comprehensive framework for understanding IT capabilities.

In developing our arguments, we make several significant contributions. First, we identify different layers of IT capabilities (e.g., Kohli & Grover, 2008; Li & Chan, 2019), from the foundational ownership of IT-related assets to operational deployment of those assets (i.e., operational IT competence) to the dynamic reconfiguration of operational capabilities (i.e., dynamic IT capabilities) in response to a shifting landscape. Second, we connect these different layers of IT capabilities to develop a multilayered conceptualisation of IT capabilities. Taken together, we contribute to the literature on IT capabilities (e.g., Chae *et al.*, 2014; Chou & Shao,

2023; Dewett & Jones, 2001) by providing a coherent understanding of the progression of IT capabilities, from tangible resource ownership to intangible strategic utilisation to continuous adaptation for sustaining competitive advantage. Last, we contribute to the RBT of IT capabilities (e.g., Bharadwaj, 2000; Bhatt & Grover, 2005; Ravichandran & Lertwongsatien, 2005) by providing a more precise understanding of how different RBT aspects explain IT capabilities. By grounding our analysis in the RBT, we integrate fragmented IT capabilities conceptualisation into a cohesive framework.

2. RBT Perspective of IT Capabilities

The intricate and multifaceted nature of the RBT is central to understanding the dynamics of competitive advantage within firms. At the heart of the RBT lies the fundamental concept that firms' competitive advantage is derived from its possession and strategic utilisation of resources. The complexity inherent in the RBT emerges from its nuanced conceptualisation of resources, which spans a diverse spectrum of tangible and intangible elements crucial for value creation (Barney, 2001; Barney *et al.*, 2001, 2011). While firms' resources can be generated internally (e.g., human resources) or obtained externally (e.g., business networks) (Barney *et al.*, 2011; Dyer & Singh, 1998), the RBT posits that they can ultimately be classified into three broad categories: assets, competence, and dynamic capabilities. This classification provides a nuanced perspective on how firms' distinct characteristics contribute to their competitive position. Specifically, "assets" encompass the tangible and intangible assets that firms can control or access, such as physical capital or financial assets (Barney, 2001; Wernerfelt, 1984). "Competence" denotes the capacity of firms to purposefully mobilise and deploy resources through routines (Amit & Schoemaker, 1993; Dutta, Zbaracki, & Bergen, 2003), know-how (Dosi, Faillo, & Marengo, 2008; Grant, 1996), and organisational culture (Barney, 1986; Fiol, 1991). This may encompass a variety of elements such as intellectual capital, knowledge, and

reputation, acknowledging the comprehensive nature of the elements contributing to firms' competitive position (Schroeder, Bates, & Junttila, 2002; Vorhies & Morgan, 2005). Finally, "dynamic capabilities" encompass firms' abilities to continuously integrate and reconfigure their competence in response to changing environments (Helfat & Winter, 2011; Teece, 2007). Thus, Danneels (2008) often refers to firms' dynamic capabilities as the competence to build new competence or "second-order competence". While assets form the foundation, competence represents the strategic deployment of these resources, and dynamic capabilities ensure adaptability over time. This holistic perspective aligns with the RBT's emphasis on integrating and strategically managing firms' distinct characteristics to achieve and sustain a competitive advantage in the dynamic business landscape.

Our review of the IT capabilities literature shows that researchers have widely adopted the RBT as a theoretical foundation to conceptualise IT capabilities and investigate their antecedents and impact under different business environments. However, researchers who adopt the RBT as a theoretical foundation for studying IT capabilities tend to conceptualise IT capabilities differently, depending on which RBT resource classification they emphasise—assets, competence, or dynamic capabilities. In considering IT capabilities derived from firms' specific assets, Huang, Ou, Chen, and Lin (2006) conceptualise IT capabilities as manifestations of IT infrastructure, human–IT resources, and IT-enabled intangibles resulting from firms' IT investments. Similarly, other researchers take a parallel view to highlight the importance of IT-related assets, including hardware, software, databases, and networks (e.g., Bharadwaj, 2000; Broadbent, Weill, & Neo, 1999; Saeed, Grover, & Hwang, 2003; Song, Nason, & Di Benedetto, 2008). Having ownership of and access to foundational IT assets is vital for firms to adequately store, process, retrieve, analyse, and transmit data in a timely manner. These IT-related assets provide the core technological building blocks that enable basic information management and communication (Sabherwal & Kirs, 1994; Sambamurthy,

Bharadwaj, & Grover, 2003). These IT – related assets also serve as an essential foundation that allows firms to leverage IT systems to enhance the value and functionality of other organisational assets, enabling improved coordination of business activities, operational management, information analysis, and customer and partner interactions (Aral & Weill, 2007; Nevo & Wade, 2010; Ross, Beath, & Goodhue, 1996; Wade & Hulland, 2004).

When considering IT capabilities that result from a specific competence of firms, Peppard, Lambert, and Edwards (2000) conceptualise IT capabilities as deriving from key organisational routines, including evaluating strategic IT opportunities, sourcing IT supply, developing and implementing IT systems, and leveraging information to generate business value. Kearns and Lederer (2003) conceptualise IT competence as comprising multidimensional constructs encompassing organisational routines that align the IT plan with the business plan. Ravichandran and Lertwongsatien (2005) define IT capabilities as high-quality and sophisticated routines within the information systems department that enable it to deliver IT services to firms, including system development capability, information system support maturity, information system operations capability, and information system planning sophistication. Besides organisational routines, researchers also acknowledge that firms' competence in effectively leveraging IT-related assets is founded on their cumulative knowledge base. Firms' ability to strategically manage and extract value from IT infrastructure, systems, and information hinges substantially on the breadth and depth of IT-related knowledge embodied within their workforce. For example, Mata, Fuerst, and Barney (1995), Tallon (2008), and Weigelt (2013) recognise that, to leverage technology investments fully, firms require knowledge of how to integrate IT tools into key business processes, roles, and decision-making processes. Last but not least, IT capabilities researchers recognise that firms' specific organisational culture plays a critical role in deploying IT assets. A culture that embraces change and innovation is more likely to view new technologies positively, with employees

eager to learn and adopt new IT systems and processes (Martínez-Caro, Cegarra-Navarro, & Alfonso-Ruiz, 2020; Schryen, 2013; Zhang *et al.*, 2013). Successful IT deployment requires leaders to promote an agile, collaborative, growth-oriented culture that provides fertile ground for technologies to flourish (Armstrong & Sambamurthy, 1999; Devece, 2013).

In examining IT capabilities stemming from firms' dynamic capabilities, Li and Chan (2019) delineate three components of IT capabilities from the dynamic capabilities perspective. Each component has reconfigured various IT-related ordinary capabilities (which we refer to as competence in our discussion). More specifically, dynamic digital platform capability has reconfigured IT infrastructure functionality, IT integration capability, and IT infrastructure flexibility. Dynamic IT management capability involves reconfiguring IT deployment capability, exploitation competence, and exploration competence. Dynamic IT knowledge management capability focuses on reconfiguring IT knowledge creation, transfer, and retention capabilities. Other researchers advance different perspectives on how firms can reconfigure existing competence of a more foundational nature to develop new, higher-order competence that effectively deploys IT-related resources in a manner aligned with the demands of an evolving business landscape (e.g., Huber, Oberländer, Faisst, & Röglinger, 2022; Lee, Lim, & Wei, 2004; Lim, Stratopoulos, & Wirjanto, 2011; McLaren, Head, Yuan, & Chan, 2011; Mikalef & Pateli, 2017).

In reviewing these studies, we found that the conceptualisation of IT capabilities is dispersed across different RBT resource classifications. Adding to the complexity, many researchers have also attempted to conceptualise IT capabilities based on multiple RBT resource classifications. For example, Dehning and Stratopoulos (2003) acknowledge that IT infrastructure (we classified this as "assets" in the RBT resource classification) and managerial IT and technical IT skills (we classified these as "competence" in the RBT resource classification) are components of firms' IT capabilities. Lu and Ramamurthy (2011)

acknowledge that IT infrastructure competence and IT business-spanning capabilities (we classified these as “competence” in the RBT resource classification) and IT proactive stance (we classified these as “dynamic capabilities” in the RBT resource classification) are components of firms’ IT capabilities. Bhatt and Grover (2005) identify specific components that can help to assess firms’ IT capabilities, among them the quality of IT infrastructure, which can be considered “assets” as per our RBT resource classification, and the intensity of organisational learning on IT implementation, which can be viewed as a type of "dynamic capabilities" within our RBT resource classification. Addressing these limitations of prior conceptualisations, this study puts forth an integrative framework to clarify the nature of IT capabilities. Unlike preceding research categorising IT capabilities narrowly within one or two RBT resource classifications, we posit that IT capabilities manifest across assets, competence, and dynamic capabilities. That is, fully understanding IT capabilities necessitates elucidating the assets forming their foundation, the competence to deploy those assets, and the dynamic capabilities driving adaptation over time. Specifically, we map out components constituting each facet while highlighting their interrelationships. Synthesising perspectives, we provide conceptual clarity regarding constituent yet interconnected elements underlying sophisticated IT capabilities.

3. Research Method

Our research aims to develop a coherent understanding of the multidimensional nature of IT capabilities using an inductive, qualitative approach grounded in RBT. Specifically, we utilise the RBT’s resource classifications as lenses and engage interviewees to discern how different IT capabilities manifest and interconnect within firms seeking competitive advantages. This inductive approach, which examines specific situations to inform wider generalisation, is well-suited for studying inherently complex phenomena with multiple intersecting dimensions

(Salvato & Rerup, 2011). Through in-depth, expert interviews (Blumberg, Cooper, & Schindler, 2014), we collect fine-grained input data on how different firms identify, acquire, and manage various IT capabilities in practice. Analysing these frontline perspectives and experiences enables us to delineate relationships among distinct IT capability components, clarifying an integrative, nuanced process model. Such an inductive methodology, drawing on established qualitative procedures, is optimal for comprehending intricate socio-technical processes (Corbin & Strauss, 2014; Corley & Gioia, 2011). By exploring professionals' interpretations of IT capability development within the RBT framing, our study aims to derive a unified set of principles for systematically cultivating and leveraging these multidimensional capabilities for competitive success. Given their complex nature, the approach provides contextual richness absent from prior fragmented perspectives while strengthening practitioners' abilities to harness IT capabilities strategically.

To ensure a rich, multi-perspective dataset for inductively delineating IT capabilities, we identified 85 UK firms across diverse industries known for strategically championing IT investments. The sample included IT firms (80% hardware manufacturers, 20% software/services) and adopters from IT-intensive sectors like finance and retail. We directly contacted these organisations to propose in-depth interviews with key decision makers shaping the management of IT capabilities. By targeting influential representatives at the frontier of IT capabilities development, we aimed to elicit fine-grained insider accounts of how they manifest and interconnect in practice. Out of 85 firms, 64 (70.59% response rate) agreed to participate, providing access to senior IT strategy perspectives (see Appendix 1). To supplement the practitioner lens, we additionally interviewed four IT academics on scholarly definitions and frameworks of IT capability. Our multi-industry sample covers the diverse organisational contexts where IT capabilities are actively managed for competitive success. By triangulating across the range of cutting-edge practitioner and academic vantage points, we are positioned

to inductively crystallise the fundamental, multidimensional essence of modern IT capabilities. The richness provides an ideal foundation for deriving integrative theories that translate to other contexts where IT is increasingly sparking capability evolution and strategic renewal.

We conducted semi-structured interviews to elicit free expressions of participants' perspectives while enabling comparison across responses to draw conclusions inductively (MacCracken, 1996). The interview process, which took place in the UK between 2013 and 2015, comprised two stages with distinct question sets (Appendix 2). All interviews lasted 45–60 minutes and were digitally recorded and transcribed. Stage 1 involved background questions on the informant's role and IT involvement. Stage 2 focused on open-ended questions about manifest IT capabilities and related business opportunities. By collecting diverse, experience-based perspectives, we aimed to inductively crystallise an acceptably comprehensive process model of IT capability development within strategic contexts. In developing questions, we followed established protocols (Berg, 2004; Eisenhardt, 1989). First, we reviewed the relevant literature on IT capabilities conceptualisations as a foundation. Next, the authors brainstormed an extensive list of potential questions to address our research aims, drawing on the key themes and debates identified. Third, we refined the questions through colleague and industry consultations to align with real-world contexts. Finally, we pilot-tested the interview guide with three practitioners and incorporated their feedback. By collecting diverse, experience-based perspectives on how IT capabilities develop within strategic contexts, we aimed to inductively crystallise an acceptably comprehensive process model. Hence, our sample covers a wide range of industries and roles actively leveraging IT capabilities. To maximise input quality, we briefed all participants on the academic purpose and nature of the research, confirming their understanding. We also guaranteed response anonymity. With rich, multi-lens input established, our subsequent analysis elicited vital relationships within the cultivation of IT capabilities and translated these into generalisable principles.

We analysed the interview transcripts through the RBT lens, with the individual firm as the unit of analysis. By focusing on the firm represented by each non-academic interviewee, we explored how IT capability building enables value creation within organisational contexts. We applied a rigorous coding process to systematically discern patterns and insights embedded across the rich interview tapestry. Meticulously analysing transcript segments, we categorised perspectives on how interviewees' firms extract business value from IT capabilities, considering every nuanced articulation. This crucial coding stage facilitated cataloguing commonalities and differences to delineate IT capability manifestation and cultivation themes inductively. Delving into fine-grained details, our analysis pinpoints the multifaceted ways in which specific capabilities take root in firms pursuing IT-driven value creation.

Subsequently, we analysed interview codes that could be categorised under "assets", "competence", and "dynamic capabilities" based on different RBT resource classifications (see Appendix 3). According to the RBT, assets constitute the tangible and intangible resources that firms possess and leverage to attain competitive advantage (Barney *et al.*, 2001, 2011). We identified codes reflecting this definition of assets (e.g., IT equipment, IT software, information access via IT, etc.) and grouped them into a category designated "IT-related assets".

Regarding competence, RBT researchers have divergent perspectives on what constitutes competence. However, the overarching premise is that firms' competence depends on their ability to execute value-creating activities that effectively mobilise and deploy their assets. By adroitly utilising these assets, the firm can differentiate from its rivals, thereby securing a competitive edge (Barney *et al.*, 2011). Our review of the RBT literature reveals three typical competence manifestations: functional routines, practical know-how, and conducive organisational culture. The functional routines represent organisational processes that enable firms to execute specialised operational tasks and deploy assets (Amit & Schoemaker, 1993; Dutta *et al.*, 2003). Applying this to our study context, firms' functional routines related to IT

capabilities encompass specific processes for mobilising and deploying assets associated with IT. Consequently, we have identified codes denoting operational procedures, guidelines, and protocols about utilising IT, indicative of functional routines aligned with IT capabilities. The embodiment of practical know-how is a nuanced amalgamation of explicit knowledge and refined skills that uniquely equips firms to adeptly leverage and implement specific assets (Dosi *et al.*, 2008; Grant, 1996). It transcends theoretical understanding, encapsulating the experiential wisdom cultivated through hands-on application and contextual adaptation. In our context, we coded firms' practical know-how regarding IT capabilities as involving the integration of specific knowledge and skills for mobilising and deploying assets associated with IT (see Appendix 3) underpinning IT capabilities. The third form of competence involves conducive organisational culture that mirrors a favourable organisational environment, characterised by shared values, beliefs, and norms governing employee interactions and decision-making. This culture enables firms to effectively mobilise and deploy specific assets, thereby fostering the development of a competitive advantage (Barney, 1986; Fiol, 1991). In our context, we have coded conducive organisational culture related to IT capabilities, signifying the presence of shared values, beliefs, and norms tailored explicitly for the mobilisation and deployment of assets associated with IT. The synergistic interplay of well-defined functional routines, practical know-how, and conducive organisational culture enables firms to perform specific value-creating activities. These activities harness the effective mobilisation and deployment of IT-related assets, culminating in attaining competitive advantages. We conceptualise these value-creating activities under the "operational IT competence" category.

Last, the RBT differentiates between competence and dynamic capabilities. The notion of competence, referred to by some RBT theorists as "ordinary capabilities", is fundamentally concerned with the proficient execution of value-creating activities. In contrast, dynamic

capabilities accentuate the firms' ability to reconfigure and recombine their existing competences to forge new competences in response to evolving external conditions (Helfat & Winter, 2011; Teece, 2007). Thus, firms' dynamic capabilities are called second-order competence (Danneels, 2008). Our study examines firms' dynamic capabilities pertaining to IT. These capabilities encompass their ability to cultivate novel competences by assimilating existing operational IT competences. The operational IT competences underpin the firms' proficiency in executing value-creating activities that effectively mobilise and deploy IT-related assets. Consequently, the firms' dynamic IT capabilities act as a meta-level mechanism, empowering them to continually reinvent their modus operandi for orchestrating different value-creating activities that aim to mobilise and deploy IT-related assets effectively. We identified and categorised codes denoting planning, learning, and realigning the utilisation of firms' IT resources as manifestations of firms' "dynamic IT capabilities".

The final step of our analysis involved identifying connections among "IT-based assets", "operational IT competence", and "dynamic IT capabilities". This was a recursive rather than linear process. We moved iteratively between these three IT capabilities categories and the emerging data patterns until an adequate integrated framework materialised. The analytical approach also built on the RBT foundation (Barney *et al.*, 2011; Danneels, 2008; Helfat & Winter, 2011), indicating that firms' competence enables them to effectively deploy their assets, while their dynamic capabilities allow them to reconfigure and recombine existing competence in order to develop new competence in light of evolving external circumstances.

4. Findings

An integrated framework of IT capabilities was developed based on our analysis (Figure 1). Specifically, we propose that firms' IT capabilities consist of three layers. At the foundational level, IT capabilities reflect firms' IT-related assets, encompassing IT

infrastructure, informational, and enabled assets that are valuable, rare, and inimitable. To effectively mobilise and deploy these IT-related assets, firms must possess corresponding operational IT competences: IT infrastructure competence (IT infrastructure flexibility competence and IT infrastructure-business alignment competence); IT information-processing competence (IT information management competence and IT information sensemaking competence); and IT-enabled competence (IT exploitation competence and IT exploration competence). At the highest level, dynamic IT capabilities—dynamic IT opportunities-sensing capability, dynamic IT opportunities-seizing capability, and dynamic IT business transformation capability—represent firms' capacity to reconfigure and assimilate various operational IT competences. In the following sections, we elucidate our findings in greater detail.

'Insert Figure 1 here'

4.1 IT-related Assets

The RBT emphasises the strategic importance of tangible and intangible assets that firms have control over and can leverage in the conception and execution of their strategies (Barney *et al.*, 2001, 2011). The influence of firms' assets on their capacity to undertake specific strategic activities is a pivotal aspect of strategic management. The allocation and composition of assets play a critical role in shaping firms' strategic capabilities. Firms rely on their assets to respond to market threats and opportunities. Drawing on this facet of the RBT, our analysis of the interviews reveals three types of IT-related assets that can be viewed as potential sources of firms' competitive advantage: *IT infrastructure assets*, *IT informational assets*, and *IT-enabled assets*.

IT infrastructure assets refer to IT investments that enable IT applications and functionality (Aral & Weill, 2007; Broadbent *et al.*, 1999; Duncan, 1995). According to the data, IT

infrastructure assets constitute the foundation underpinning all of the firms' IT functions. The IT infrastructure asset consists of two primary components: technical and human (Broadbent & Weill, 1997; Byrd & Turner, 2000). The technical component typically encompasses hardware, software, network systems, and any tangible IT-related assets with potential business applications. The human component comprises personnel hired by firms to implement IT operations and manage the associated infrastructure. One respondent commented:

> "My definition of a highly IT-capable organisation is one that not only has the properly installed IT hardware and systems, but also has employees who understand how to use it properly. You cannot use IT to create an advantage in the marketplace if you do not possess both elements." (Engineer, IT sector)

A director from the financial sector added:

> "Our number one concern is to keep the [IT] system available and working at all times. To do so, we need to build a reliable [IT] system and have people [with necessary knowledge] to maintain and manage it […], if the system is down, there is no point discussing anything related to IT capability."

Aligning with findings from prior studies, the informants concur that the IT infrastructure asset constitutes the foundation underpinning IT capabilities (Bharadwaj, 2000; Dehning & Stratopoulos, 2003; Ravichandran & Lertwongsatien, 2005).

The second category of IT-related assets encompasses IT informational assets. Davis and Golicic (2010) indicate that, in a business context, the term "information" typically incorporates a wide array of elements, including the products, production processes, customers, resources of the firm, and analogous information about competitors' products, production processes, customers, and resources, along with other pertinent business and market information. An IT informational asset is the information generated or disseminated through information systems concerning firms' responsiveness, control, reliability, and adaptability (Aral & Weill, 2007; Galliers, 2006). The literature implicitly indicates a close connection between firms' IT informational assets and positive performance (Mithas, Ramasubbu, &

Sambamurthy, 2011; Weill & Broadbent, 2009). The perspectives derived from field interviews align with the existing literature, as exemplified below:

> "[…], we set up our IT to collect all of the necessary information about our customers, i.e., how often they visit…and so on. […]. This information enables us to react quickly to the market condition, because it is delivered quickly from one part of the company to another." (Marketing Manager, service sector)

> "You can have all this information, so what? If you cannot analyse and translate it into useful solutions or directions that you can act upon, it is pointless collecting it." (Service Manager, IT sector)

Our findings indicate that the progression of information systems enables firms to process a greater volume of intricate information, thereby augmenting their capacity to identify and capitalise on market opportunities. Companies that possess efficient communication channels for disseminating IT informational assets across internal business units and external partners exhibit a heightened ability to respond promptly compared to their competitors (Lai *et al.*, 2008; Melville *et al.*, 2004; Tallon, 2008). By using IT to manage information generation and dissemination, firms can improve their responsiveness and enable more effective decision making, thereby improving their competitiveness.

The third category of IT-related assets pertains to IT-enabled assets. These are tangible or intangible resources that, when integrated with IT systems, can underpin business operations and create value for the firm (Bharadwaj, 2000; Nevo & Wade, 2010). Put differently, the realisation of the potential of such assets is contingent upon firms adopting the appropriate IT support.

> "It is my opinion that the IT systems themselves are not valuable. The value of IT comes from the combination of the IT system with the organisation's resources to deliver value to the customers. Managers can increase the value of IT by either searching for new ways to apply [the existing] information system to improve the business function or investing in a new information system which brings new features that organisations can use to develop new services for their customers." (IT Manager, financial sector)

This implies that firms can enhance the value of their assets by integrating IT with other resources. The concept of IT-enabled assets underscores the notion that IT can only yield

competitive value when synergistically combined with firms' existing assets. The principal value indicator for IT-enabled assets often aligns with the concept of synergy, which posits that a cohesive group is greater than the sum of its individual components. Chen, Preston, and Xia (2010) further categorise the firms' activities into the supply-side (emergent synergy), emphasising synergy creation from existing IT investments and IT-enabled assets, and the demand-side (potential synergy), focusing on the development of prospective synergy from new IT investments and IT-enabled assets. In summary of the discussions above, we posit:

> *Proposition 1: The cornerstone of firms' IT capabilities lies in their IT-based assets, which can be aptly categorised as IT infrastructure, IT informational, and IT-enabled assets.*

4.2 Operational IT Competence

According to the RBT, firms' competence stems from their ability to effectively perform certain value-creating activities to mobilise and deploy assets (Krasnikov & Jayachandran, 2008). Our analysis begins by identifying three typical competence manifestations—functional routines (Amit & Schoemaker, 1993; Dutta *et al.*, 2003), practical know-how (Dosi *et al.*, 2008; Grant, 1996), and conducive organisational culture (Barney, 1986; Fiol, 1991). Furthermore, we identify the specific value-creating activities derived from the unique combinations of functional routines, practical know-how, and conducive organisational culture that allow firms to deploy their IT-related assets (see Table 1). We term this phenomenon "operational IT competence" and apply the theoretical lens of the RBT to examine its various forms associated with mobilising and deploying IT-related assets.

'Insert Table 1 Here'

4.2.1. IT Infrastructure Competence

The first type of operational IT competence identified through our data analysis is IT infrastructure competence. This competence reflects firms' ability to mobilise and deploy their

IT infrastructure assets through specific value-creating activities. It comprises two key components: IT infrastructure flexibility competence (Table 2) and IT infrastructure–business alignment competence (Table 3).

‘Insert Table 2 Here’

‘Insert Table 3 Here’

IT infrastructure flexibility competence enables firms to build and modify their IT infrastructure assets, facilitating rapid development and implementation of IT applications while providing reliable support for business operations across diverse situations (McLaren *et al.*, 2011; Ray, Barney, & Muhanna, 2004). Three value-creating activities contribute to the formation of this competence (see Table 1). First, “unveiling innovative IT tactics” involves a multifaceted approach that ensures the continuous improvement and adaptation of IT infrastructure to meet evolving demands. This process entails searching for and promoting various methodologies for manipulating the IT infrastructure, which is fundamental in discovering alternative strategies to enhance system performance, security, and flexibility. Acquiring knowledge of the diverse applications of the IT infrastructure empowers IT professionals to understand the full potential of existing systems and how they can be adapted or extended through innovative practices. Moreover, encouraging and rewarding staff to experiment with new IT approaches to problem solving fosters a culture of innovation, as evidenced by this quote from a technical architect in the service sector.

> “We are looking for many different ways to apply our technology. […] we found that it not only gives us more choice of method when faced with different requests from our clients, but also helps us to save a lot of money through not purchasing new equipment to deal with clients’ special requests.”

Second, “engineering adaptable infrastructure solutions” involves designing and building an IT infrastructure that prioritises the flexibility of technical components. This approach enables the infrastructure to accommodate future technological advancements and changing business needs without requiring complete overhauls. However, several informants suggested

that there is a limit to this flexibility and that, in some cases, it may be more cost-effective to purchase a new, more powerful information system:

> "I understood the rationale [i.e., cost saving] for them to achieve greater flexibility. However, I personally find this is not always the case. […]. Although investing in a new system may be costly, it is usually more powerful than the old one, and you also do not need to spend a lot of money [on wages for IT specialists] to reconfigure it." (IT Manager, service sector)

Nevertheless, training staff in technical and managerial skills is necessary for adding, modifying, and removing IT infrastructure components, aligning with prior studies suggesting that employee skill levels play a pivotal role in IT infrastructure flexibility (Aral & Weill, 2007; Dong, Xu, & Zhu, 2009; Ray *et al.*, 2004). An IT manager in the IT sector highlighted the importance of this training.

> "You cannot expect to buy a system that can do everything. […]. Therefore, we need to have the knowledge to modify it or design an application to allow us to use the system in different ways. So, we need to train people to do it [system modification]."

Additionally, firms must have an organisational culture that stresses the facilitation of idea sharing between business units through regular formal and informal meetings to refine their IT strategies and adapt more effectively to market shifts.

Third, "fortifying systemic reliability" focuses on ensuring that the infrastructure not only supports a variety of IT strategies for problem solving but also remains resilient in the face of evolving technological landscapes and market demands. This involves implementing robust systems and protocols that guarantee the continuous operation of IT services. By focusing on system reliability, firms can ensure that their IT infrastructure provides a stable foundation for various technological approaches, enabling consistent and effective solution-finding processes. This echoes suggestions from prior studies that reliability constitutes the backbone of IT infrastructure flexibility (Kumar, 2004; Ray *et al.*, 2004). Furthermore, developing a deep reservoir of practical knowledge within the team enables the firm to swiftly adapt to new technologies and methodologies, ensuring that the IT infrastructure can evolve in line with

technological advancements and organisational needs. Our interviewees emphasised the importance of senior management establishing communication platforms to facilitate new idea sharing across the business operational units, as illustrated by this quote from an IT manager in the IT sector.

> "We organise regular meetings and a message board to ensure that we can share ideas about innovative ways of applying our technology. People are encouraged to share their ideas freely across the organisation. Rewards are given for the best ideas for each period to encourage these activities." (IT Manager, IT sector)

This facilitates the unrestricted transfer of ideas within the firm, enabling it to harness the collective wisdom of its entire workforce (Aral & Weill, 2007; Bharadwaj, 2000).

The second component of IT infrastructure competence is IT infrastructure–business alignment competence, which reflects firms' ability to organise their IT infrastructure assets coherently to integrate them with their business operations for the achievement of strategic objectives (Gerow, Thatcher, & Grover, 2015; Rai, Pavlou, Im, & Du, 2012; Sabherwal & Kirs, 1994). Two value-creating activities contribute to the formation of this competence (see Table 1). First, "IT design for customer goals" begins with identifying the current and future needs of customers, which serves as a critical step in forming clear business objectives.

> "Our team has to constantly identify what we need to meet the requirements of new services that our company wants to provide in the marketplace." (Director, financial sector)

This requires a deep understanding of the market, customer behaviour, and emerging trends to ensure that the IT design is not only responsive to current demands but is also forward-looking, capable of adapting to future customer needs. However, some informants, particularly those from the IT sector, opposed the necessity for perfect alignment between IT infrastructure assets and business operations, indicating the difficulty in predicting the future and noting that, despite plans, the business environment can change dramatically at times. As a product manager from the IT sector suggests:

> "Many years ago, we mainly offered online services, and now we are shifting some of our focus to offering services through apps [i.e., Apple and Androids]. Our industry changes very fast. […]. Although it is nice to have a long-term plan for building your information system and making it perfectly aligned with your business, you also need to prepare for sudden changes in the industry."

Underpinning this process requires practical know-how, encompassing a comprehensive understanding of methods for identifying customer needs and a firm-specific knowledge of business operations and IT applications, as highlighted by a service manager in the IT sector:

> "Training is essential for us because new recruits only learn general knowledge at school, but we are discussing technology highly related to our business. At the same time, we also want them to have a taste for the general market trends in our business, so they can have a better idea about how to set up the system properly." (Service Manager, IT sector)

Furthermore, establishing organisation-wide hiring and purchasing guidelines reflects the importance of a conducive organisational culture in supporting IT design for customer goals, ensuring that the firm attracts and retains talent aligned with its customer-centric vision and that purchasing decisions contribute to meeting customer needs.

Second, "coordinating IT and business goals" is an endeavour that ensures that IT strategies are not only aligned with but also actively support the achievement of business objectives, thereby enhancing the overall performance and competitiveness of the firm. The process begins with effective communication among different business departments, a critical functional routine that facilitates the alignment of IT infrastructure resources with business objectives. This involves regular dialogue between IT specialists and business unit leaders to ensure that the IT infrastructure is responsive to the needs of various departments. Adjusting IT resources according to business objectives requires a dynamic approach to IT management, where decisions on IT investments and resource allocation are made with a clear understanding of their impact on business goals. Underpinning this alignment requires training in technical and managerial skills, which constitutes the practical know-how essential for linking IT investment and performance, as highlighted by a marketing manager in the retail sector:

> "We need to have a clear understanding about what business we are in and have a good mixture of the right people who possess the knowledge about both IT and our business objective."

Once IT infrastructure–business alignment has been established, firms must concentrate on sustaining it by ensuring that different business units communicate to adjust the IT infrastructure accordingly for new goals, as a consultant in the financial sector explained:

> "The business needs to always assess the impact of using IT and determine whether it has helped to enhance its performance. Often, every two or three months, our team needs to adjust our information system to give the maximum boost to our business performance. […]. We can always benefit from good communication. For example, if the sales department senses changes in consumer tastes and passes this information on to us [the IT department], we can adjust our system ahead of our competitors." (Consultant, financial sector)

Cultivating an organisational culture that coordinates inter-unit activities can bolster IT infrastructure–business alignment, as suggested by prior studies (Chan & Reich, 2007; Huang & Hu, 2007). Our informants stressed the value of instituting firm-wide guidelines on organising IT infrastructure to fulfil business needs, enabling clear articulation of overarching business objectives and the IT role.

In summary, IT infrastructure competence comprises IT infrastructure flexibility competence and IT infrastructure–business alignment competence. These competences enable firms to mobilise and deploy their IT infrastructure assets effectively through various value-creating activities related to unveiling innovative IT tactics, engineering adaptable infrastructure solutions, fortifying systemic reliability, IT design for customer goals, and coordinating IT and business goals. The unique combination of functional routines, practical know-how, and a conducive organisational culture contributes to the formation of these competences, allowing firms to leverage their IT infrastructure assets for competitive advantage. As a result of the preceding discussions, we propose the following:

> *Proposition 2: IT infrastructure competence involves IT infrastructure flexibility competence and IT infrastructure–business alignment competence, enhancing the likelihood of firms' effective mobilisation and deployment of IT infrastructure assets.*

4.2.2 IT Information-processing Competence

The second type of operational IT competence is IT information-processing competence. IT information-processing competence delineates firms' capacity to effectively mobilise and deploy the informational assets they possess (Mithas *et al.*, 2011; Peppard *et al.*, 2000). Our data analysis reveals the existence of two distinct forms of IT information-processing competence: IT information management competence (Table 4) and IT information sensemaking competence (Table 5).

'Insert Table 4 here'

'Insert Table 5 here'

Information management plays a pivotal role in the integration of IT informational assets, encompassing processes such as information collection, distribution, storage, and related activities (Barwise & Seligman, 1997). Such information usually pertains, at a minimum, to a firm's products and production processes, its customers and resources, as well as the corresponding elements of its competitors. Attaining an "informational advantage" should stand as a critical objective in firms' IT strategy. This advantage is achieved through more effective management and utilisation of this marketing intelligence compared to rival firms. Clear managerial guidelines and organisation-wide standards and policies should reflect this objective. Thus, IT information management competence reflects firms' ability to effectively manage their IT informational assets derived from information systems. Two value-creating activities contribute to the formation of this competence (see Table 1). First, "establishing data management protocols" ensures the efficient and secure handling of data, an invaluable asset in today's information-driven business environment. This process involves setting up data management guidelines encompassing data collection, entry, distribution, storage, and other related processes. These guidelines form the backbone of the firm's data management strategy, ensuring standardised, efficient, and compliant data handling procedures (Alavi & Leidner,

2001; Wang & Meng, 2019). Tracking market changes and competitors' movements is also essential, involving regularly gathering and analysing data on market trends and competitor activities to inform strategic decisions (Aral & Weill, 2007; Mithas *et al.*, 2011).

> "The major strength we have is that our IT system can provide us with the most up-to-date information about marketing, our competitors, our customer feedback, and so on. It allows us to micro-manage the strategies for meeting those needs." (Financial Analyst, financial sector)

Integrating this market intelligence into the protocols enables responsive strategies, thereby maintaining a competitive edge. Underpinning these routines requires acquiring and managing information alongside database skills training.

> "The question is really about whether you know where to search for the correct information and, once found, how to store it correctly. Therefore, it is important for the company to provide training on this topic for the IT staff before assembling the system." (Service Manager, IT sector)

This practical know-how is essential for implementing the guidelines and making informed decisions from market intelligence. Furthermore, organising cooperative data collection and sharing efforts encourages collaboration, breaking down silos, and fostering shared data management responsibility (Bharadwaj, 2000; Melville *et al.*, 2004).

Second, "safeguarding information integrity" is pivotal for protecting information confidentiality and reliability. Implementing robust security measures like firewalls, encryption, access controls, and audits creates a secure infrastructure safeguarding critical information (Mithas *et al.*, 2011; Siponen, 2005).

> "Information security is important for us. […]. We need to protect our data because that is where our competitive advantage comes from. Therefore, we need to not only ensure that the right people get the right information to make better decisions, but also ensure that the wrong people have no access to the important information." (Learning Solution Specialist, retail sector)

Simultaneously, some informants also highlight that, on occasion, excessive information protection may result in missed business opportunities. For example, a marketing manager from the retail sector remarks:

> "We have experienced one instance in the past where one department of our company did not want to share information with the others due to security reasons. […]. It translated into a big missed business opportunity. Therefore, we have established a standard procedure about information sharing, whereby all of our departments can share data with each other without worrying about information security."

While excessive protection may result in missed opportunities, priorities should ensure that the right people get the correct information for better decisions while restricting unauthorised access. Complementing security routines is practical know-how on threats, risks and prevention. Acquiring this knowledge enables staff to identify, mitigate, and respond to risks effectively. Furthermore, establishing an organisation-wide data management standard for data handling, storage, access, and sharing ensures consistency and compliance. By embedding these standards into the organisational culture, businesses can create an environment where data management and security are integral to everyday operations. This cultural shift encourages accountability and collective responsibility among all staff members, promoting practices that protect data integrity and confidentiality.

IT information sensemaking competence reflects firms' ability to understand what is happening by interpreting the meaning of data (IT informational assets) generated from information systems (Alavi & Leidner, 2001; McLaren *et al.*, 2011). Three value-creating activities contribute to the formation of this competence (see Table 1). First, "business environment monitoring" enables adaptation to changing market conditions. Tracking economic trends, technological advancements, regulations, and competitive dynamics provides the foundation (Melville *et al.*, 2004; Schryen, 2013).

> "Having a general understanding of the market conditions and data analysis skills is important. Moreover, the employees should also have industry-specific knowledge. For example, the same information, such as consumer data relating to different industries [i.e., the retail industry] has a different way of being decoded. […]. It all comes down to the expertise of a particular industry." (Head of Department, UK higher education sector)

Complementing monitoring is acquiring knowledge of the general market and specific industry conditions, representing the practical know-how essential for informed decisions.

Understanding broader conditions provides context, while industry-specific insights enable tailored, aligned responses to navigate complexities accurately and confidently. Furthermore, the culture promotes the free flow of information and insights across different parts of the firm, breaking down silos and fostering collaboration. This collaborative approach not only enriches the analysis of external factors but also facilitates the development of cohesive and adaptive strategies that reflect the integrated insights of multiple business units.

Second, "data analysis model development" empowers informed decision making through data. Developing a data analysis model as a functional routine is at the core of this process. This model is designed to organise and process information efficiently, ensuring both speed and accuracy in data handling. The data analysis and interpretation skills underpin the effectiveness of the data analysis model, representing the practical know-how necessary for extracting meaningful insights from complex datasets.

> "Without truly understanding what your customer thinks from the data, all of your IT investment will be worthless. […]. Moreover, for companies that are not really IT-capable, it will take them ages to analyse the data, and they often come up with incorrect or out-of-date conclusions." (Consultant, financial sector)

Underpinning effectiveness are data analysis and interpretation skills for extracting meaningful insights (Bharadwaj, 2000). This dual focus on analysis and interpretation ensures that data insights are not only accurate but also relevant and actionable. Furthermore, a conductive organisational culture that values collaborative learning and knowledge sharing is fostered when communities within the organisation are developed to share data analysis and result interpretation experiences. Firms can cultivate an environment where data-driven decision making becomes a shared norm by facilitating open communication and collaboration around data analysis practices. Additionally, establishing a central data analysis department or functional unit exemplifies the commitment to a conductive organisational culture, centralising expertise and resources to support the firm's data analysis needs.

> "We provide services in different regions. […] In every region, we need to include some local factors to customise our service. Therefore, having a central data management department facility may not be feasible." (Marketing Manager, retail sector)

This central unit can provide specialised support to various departments, ensuring that data analysis practices align with firms' overall strategic goals. It also acts as a hub for innovation in data analysis methodologies, continuously enhancing firms' data processing and interpretation capabilities.

Third, "custom inquiry and reporting" enables tailored insights addressing specific scenarios. Identifying unique questions and developing targeted inquiries extracts relevant data (Mithas *et al.*, 2011). A critical function routine involves generating inquiries and reports for specific scenarios. Using targeted inquiries to extract relevant data from the organisation's information systems involves identifying unique business questions or challenges. By creating customised reports, departments can address the specific needs of their departments or make informed decisions based on specific market conditions or internal challenges. By systematically approaching the creation of these reports, firms can ensure that they are accurate and relevant to the scenario. Underlying the generation of these reports are scenario analysis skills, which constitute the practical know-how necessary for understanding and anticipating the potential impacts of various business scenarios.

> "We are in the information age. Every company I know has information about customers, competitors, etc. […]. The real challenge here is to process and make sense of this information. Therefore, I believe it [IT capability] is all about the data process competence. To be a winner, your company needs to have the ability to analyse the data and draw a story from it." (IT Technician, IT sector)

Creating accurate and relevant reports is crucial for responding to nuanced needs. Underlying report generation are scenario analysis skills for anticipating potential impacts, enabling actionable insights. Evaluating outcomes guides strategic decisions from custom reports. Moreover, sharing reports ensures that insights reach the relevant stakeholders, promoting

informed decisions. This collaborative approach enhances collective intelligence, ensuring that decisions reflect comprehensive scenario understanding.

> "It always comes down to team efforts to understand what the data mean. Therefore, it is really a test of the company's organisational skills to group these people together to share ideas and exchange insights on different interpretations. What we can do as a company is to set up many communities [both formal and informal] to encourage them to communicate with each other." (IT Manager, service sector)

By encouraging open communication and the exchange of reports, businesses can ensure that strategic decisions are informed by a comprehensive understanding of the firms' specific scenarios. Effective information management, security protocols, analytical models, and custom reporting underpin IT information-processing competence. Complementing robust functional routines builds skills, fosters collaboration, and nurtures a conductive culture. This enhances data handling and extracting meaning from data to maintain an informational advantage. Hence, we suggest the following proposition:

> *Proposition 3: IT information-processing competence involves IT information management competence and IT information sensemaking competence, enhancing the likelihood of firms' effective mobilisation and deployment of IT informational assets.*

4.2.3 IT-enabled Competence

The final category of operational IT competence is IT-enabled competence, which signifies firms' ability to mobilise and deploy IT-enabled assets. Our data analysis delineates that IT-enabled competence encompasses two fundamental dimensions: IT exploitation competence (Table 6) and IT exploration competence (Table 7).

'Insert Table 6 here'

"Insert Table 7 here'

IT exploitation competence signifies firms' capacity to adapt and enhance existing IT applications with the aim of further augmenting the value derived from IT-enabled assets (Chen *et al.*, 2010; Dehning & Stratopoulos, 2003). Two value-creating activities contribute to the formation of this competence (see Table 1). First, "evaluating IT strategic influence on

operations" requires examining how IT systems currently impact operations alongside assessing potential enhancements and integrations. Identifying current IT impacts enables firms to recognize areas of success and potential improvement while analysing unintegrated functions, which helps to identify opportunities for IT integration.

> "We also try to find out about new ways to use our IT potential. […]. We estimate that only 30% of our IT potential has been used so far, and we are still looking for new ways to use it under our business model. We do not want to rush too fast into purchasing new IT equipment." (Marketing Manager, service sector)

Understanding the current IT landscape and its operational implications enables firms to recognise areas of success and areas for potential improvement. Possession of knowledge on potential IT applications represents essential practical know-how, allowing the identification of underutilised capabilities and opportunities for meeting emerging needs (Dehning & Stratopoulos, 2003; Dong *et al.*, 2009).

> "The company needs to provide training support when using IT in different applications of the business. […]. However, much of the training that the company provides appears to be low-level, basic training. In my view, more training should take place to teach employees how to integrate IT in their current job." (Service Manager, service sector)

Understanding how to integrate IT applications with business objectives enriches this know-how. Furthermore, empowering employees to utilise IT capabilities fully enhances efficiency and fosters innovation. Insights sharing across departments also leverages diverse perspectives to enrich strategic IT use.

Second, "orchestrating an IT competitive strategy" aims to leverage existing IT systems to create competitive value through effective resource utilisation. This involves designing ways to align IT capabilities with strategic objectives to create value. Identifying opportunities to enhance performance through efficiency, innovation, and customer engagement facilitates implementing targeted IT applications, as suggested by an IT manager from the service sector:

> "Once you have identified where the problem is, things become less complicated. I just send our engineering team to take care of it [adopting IT in that operational area].

> Sometimes, they may need to twist [modify] our technology a little. But, it is usually not a big deal."

Training IT staff in business operations represents critical know-how, enabling solutions aligned with needs and goals. IT system modification expertise allows customisations to respond to evolving strategies and pressures. Furthermore, an environment where IT adoption is integral to success ensures maximum impact on competitive strategy.

> "The key task is to ensure that all of the departments are comfortable with the IT [existing IT applications] functions and willing to adopt them into their business operations. I feel it is my responsibility to encourage them and create an atmosphere of innovation." (Marketing Manager, financial sector)

This organisational culture ensures that IT is embedded in all aspects of the business, maximising its impact on competitive strategy.

Conversely, the exploration approach centres on identifying new business opportunities and innovations that can arise from fresh IT investments (Chen *et al.*, 2010; Dehning & Stratopoulos, 2003). Accordingly, IT exploration competence reflects firms' ability to explore new IT applications and integrate them with their IT-enabled assets to enhance revenue generation and improve profitability. Two value-creating activities contribute to the formation of this competence (see Table 1). First, "enhancing functions with new IT applications" leverages advancements through thoughtful integration and refining of operations. Identifying opportunities for efficiency, productivity, and innovation improvements prompts this initiative. An IT manager from the service sector suggests:

> "You should not just want to follow the market trend to update your IT. […]. You also need to think about the future. What business are you in? What is the future market trend? And how should you respond in terms of your IT investment and the opportunities you want to generate in the future?"

Continuously updating employee awareness of new IT functions and inventions enables the assessment of implications and strategic planning.

> "The employees need to have knowledge about your current product portfolio in comparison with the future market trend. […]. They also need to acquire knowledge about the development trends in IT hardware and software. This combination of

> knowledge and experience can help us to understand the future demands of the market and make the necessary IT investment. It can also help us to be aware of what kind of application can be integrated into our current product offering." (IT Manager, service sector)

This aligns with previous studies that emphasise the critical role of enhancing employees' awareness of new IT developments in facilitating explorative activities when mobilising and deploying IT-enabled assets (Bharadwaj, Sambamurthy, & Zmud, 1999; Chen *et al.*, 2010). The informants also highlight that firms should ensure that employees possess the necessary knowledge to integrate and modify new IT investments into business operations. Firms must cultivate an appropriate organisational culture that encourages their employees to explore new, IT-driven business opportunities to achieve this.

> "To explore the new technology, it must be the up-down commitment from the senior managers to encourage employees to do so. It is very hard to coordinate among employees in different departments if there is no commitment by the senior management team to coordinating ideas sharing and showing a willingness to adopt new technology." (Head of IT, financial sector)

Our findings indicate that firms can motivate their employees to explore new IT opportunities by showcasing the firms' readiness to invest in feasible ideas. It is imperative to possess know-how about new IT development and its potential impact on business operations. This knowledge enables organisations to anticipate the implications of new technologies and strategically plan their integration into business functions. Consistent with previous studies (Dong *et al.*, 2009; Kearns & Lederer, 2003), fostering information sharing and incentivising employees' creativity can also stimulate explorative activities. Furthermore, showcasing readiness to invest in feasible ideas motivates exploration, alongside incentivising creativity and coordinating idea sharing. Addressing concerns and demonstrating value facilitates effective integration into all functions.

Second, "uncovering opportunities via new IT acquisitions" involves exploration, integration, and encouragement. Deliberately searching for innovations and fresh investments can spur moves beyond technological trends towards value creation and new market capture.

> "We are consistently investing in new technology to meet the future demands of the business. The [IT] technology is changing at a very fast pace. We can always identify the new [IT] technology that can help us to improve our current service and bring our business to a new level. So, we need to always keep our eyes open." (IT Manager, financial sector)

By actively exploring the potential applications of emerging IT solutions, organisations can uncover novel ways to solve existing problems, enhance customer experiences, and create new products or services. Integral knowledge enables transforming operations by effectively leveraging new acquisitions.

> "We can use IT to improve our business operation and to make it better and more effective. That is nothing new for anybody, but what we did differently here is that we always try to find out whether we have maximised our IT potential yet. We always ask ourselves whether, if we applied IT differently here, we could improve our business function to better serve our customers." (Head of IT, financial sector)

Developing this expertise within the organisation is critical for ensuring that new IT acquisitions are not just added to the existing technological stack but are effectively leveraged to transform business operations. In addition, encouraging staff to explore new IT-driven business opportunities fosters an environment where experimentation is valued, and employees feel empowered to propose and pursue innovative ideas. By cultivating a culture that supports risk taking and innovation, organisations can tap into the collective creativity of their workforce, unlocking a wealth of ideas for using new IT investments to drive business growth and innovation. In summary, adapting existing assets and exploring new solutions underpin IT-enabled competence. Evaluation, planning, integration, skills building, and cultural cultivation enable the maximisation of value from IT investments. Thus, we propose:

> *Proposition 4: IT-enabled competence involves IT exploitation competence and IT exploration competence, enhancing the likelihood of firms' effective mobilisation and deployment of IT-enabled assets.*

Bringing together the preceding arguments, we propose that operational IT competence comprises three types—IT infrastructure competence, IT information-processing competence, and IT-enabled competence. Each type of operational IT competence facilitates the

mobilisation and deployment of different corresponding IT-related assets, contributing to the generation of competitive advantage for the firms. Thus, we propose:

> *Proposition 5: From the perspective of organisational competence, IT capabilities can be characterised as consisting of IT infrastructure competence, IT information-processing competence, and IT-enabled competence, which contribute to mobilising and deploying IT infrastructure assets, IT informational assets, and IT-enabled assets, respectively, to create competitive advantage for firms.*

4.3 Dynamic IT Capabilities

Teece (2007) disaggregates dynamic capabilities into sensing, seizing, and transforming capacities. As per the RBT, these represent higher-order competence for new value creation via combining and assimilating existing organisational competence (Danneels, 2008; Helfat & Winter, 2011). Our analysis unveils firms with specific top-tier capabilities to reconfigure various operational IT competence for sensing opportunities, capturing value, and enabling continuous renewal—categorised as dynamic IT capabilities.

The first dynamic IT capability is dynamic IT opportunity-sensing capability. We define this as firms' capacity to strategically plan IT infrastructure construction and modification to facilitate generating, disseminating, and interpreting information for identifying IT-related business opportunities. Our analysis suggests that firms' dynamic IT sensing capability represents an aptitude for assimilating two operational competences—IT infrastructure competence and IT information-processing competence. As discussed above, potent IT information-processing competence enables firms to recognise current and predict future business demands, potentially enhancing performance. Our results reveal that integration with IT infrastructure competence may augment such competence. When firms adeptly build and modify their IT infrastructure to align with their business objectives, they can likewise design IT systems to boost information flows and analysis. As one informant proposed, IT infrastructure competence thereby empowers firms to hone the systems facilitating opportunity comprehension:

> "You need to make sure that you make a detailed plan before you invest in developing an information system. It is important that your information system can meet the business requirements for information management. Of course, it also means that you need to make the necessary adjustment if it does not." (IT Specialist, IT sector)

This entails strategic IT infrastructure design and development to institute organisation-wide data governance guiding enterprise information flows. Such efforts enable rapid cross-departmental data access for employees, facilitating more effective decision making, as the below quote suggests:

> "We establish a data management centre to store the data that we have collected from customers, external partners, and so on. Employees from different departments can access and use the data to make important business decisions." (IT Manager, retail sector)

This also signifies that firms must competently construct IT infrastructure accommodating particular information generation, dissemination, and interpretation needs, with ample flexibility for adjustments as required. As one informant illustrated:

> "We are constantly modifying our IT application to meet our business needs. […]. It is impossible to develop an IT application and expect that it can be used for life. The market is changing all the time. We rely on our frontline workers to provide feedback about our customers' new needs and will act accordingly." (IT Manager, service sector)

In general, possessing dynamic IT opportunities-sensing capability allows firms to integrate and assimilate IT infrastructure competence and IT information-processing competence. This combination of operational IT competence empowers firms to design and construct superior IT infrastructure, enhancing information management and decision making. Consequently, firms can identify new IT-related business opportunities. Hence, we propose:

> *Proposition 6: The capability of firms to effectively combine and assimilate IT infrastructure competence and IT information-processing competence can be aptly described as dynamic IT opportunities-sensing capability.*

The second dynamic IT capability is dynamic IT opportunity-seizing capability, defined as the strategic enhancement of cross-unit information flows to bolster integration between firm IT applications and other organisational assets (IT-enabled assets) when capitalising on

business opportunities. Our analysis suggests this rebuilding represents assimilating two operational IT competences—IT information-processing competence and IT-enabled competence. As established, potent information processing allows firms to capture, analyse and transfer insights across business units, enabling more precise identification of operational weaknesses and potential opportunities related to IT applications and IT-enabled asset interactions (Lee *et al.*, 2004; Rai *et al.*, 2012). The CEO of a retail company says:

> "Information flow from department to department is critical for our success. The live data are not only important in helping us to detect the needs of our customers but also provide us with a signal for system improvement. For example, if a customer complains about a particular function of our package tracking system, our engineers will find a way to improve it."

The results of our study indicate that firms with greater IT-enabled competence are more likely to address this lack of synergy. More specifically, firms with IT exploitation competence can search for and implement solutions to modify existing IT applications to make them more closely integrated with their IT-enabled assets in order to recognise potential business opportunities. The quotation illustrates this point:

> "Based on what we learn from the reports of defects [lack of synergy between current information system settings and customer demands], my team will focus on developing solutions. These solutions usually revolve around modifying and making necessary adjustments of our existing IT in different ways to make it more aligned to our current business needs." (Service Manager, financial sector)

Aside from this approach, informants also suggest that firms can explore new and more updated IT systems to ensure a close integration between IT applications and IT-enabled assets. For example, an application manager from the IT sector suggests:

> "Our IT systems need to be updated all the time, […] because our company always tries to find new ways to serve our customers or improve our service functions. Therefore, we are always searching for new ways [i.e., acquire new IT applications] to upgrade our systems in order to support the new services that we are offered. […]. The good news is that we can easily learn about the trend of customer demands and the future strategic direction about our company through our information-sharing system. It gives us some hints about what is likely to happen, so we can start our search earlier."

Combining the outcomes from the above discussion, we suggest that firms with dynamic IT opportunities-seizing capability can combine and assimilate IT information-processing competence and IT-enabled capability. Combining these operational IT comptences enables firms to exploit and explore IT-related opportunities more effectively due to the faster and more accurate sharing of knowledge capital across business units. Thus, we propose:

> *Proposition 7: The capability of firms to effectively combine and assimilate IT information-processing competence and IT-enabled competence can be aptly described as dynamic IT opportunities-seizing capability.*

The final type of dynamic IT capability, termed dynamic IT business transformation capability, is defined as the continuous reconfiguration and rejuvenation of IT infrastructure to preserve adaptive responsiveness when confronting rapid market shifts. Our analysis indicates that this dynamic IT capability represents integrating two operational IT competence—IT-enabled competence and IT infrastructure competence. IT scholars posit that firms must continuously adapt IT strategies per market and technology changes to accommodate new operation requirements for sustained profitable growth (Li & Chan, 2019; Lim *et al.*, 2011). Our findings reveal that IT-enabled competence empowers such realignment through two approaches. The exploitation approach entails persistently modifying and refining extant IT applications to support operations facing new demands, as the excerpt below illustrates:

> "You can have all the applications [IT applications] that you want, but if the organisation is unwilling to commit to searching its potential and refining it to suit the needs of business [customer service functions], you cannot get very far. […]. Also, these needs [customer service functions] change very often as customers frequently change their preferences. So, we need to refine it all the time […]." (IT Manager, service sector)

In the exploration approach, new investments are made in acquiring IT infrastructure that can be used to develop new IT applications. An information manager from the financial sector suggests:

> "Our team is always searching for new applications that can add to our existing system. […]. In our industry, we can lose a big business deal if others [competitors] offer more services than we do."

Both approaches demonstrate a concerted effort by firms to revamp their IT-driven business operations in response to emerging demands. Our data analysis reveals that the effectiveness of these initiatives can be amplified through seamless integration with IT infrastructure expertise. Possessing IT infrastructure competence offers a distinct advantage in bolstering IT-related exploitation and exploration strategies, as it emphasises the preservation of flexibility within IT infrastructure assets and their systematic organisation to align seamlessly with business objectives. To further elaborate, a meticulously crafted IT infrastructure, designed for effortless modification and realignment in accordance with evolving business needs, empowers firms to continuously revitalise their IT applications in response to dynamic demands across various aspects of their business functions. The following quotes support the above discussions:

> "I am interested in exploring how flexibly IT can be used to assist our project when the business environment changes. We pay a lot of attention to searching for a better method and logic to design." (IT Officer, IT sector)

> "You cannot design new applications [IT application] to support your new business functions if the related IT infrastructure does not exist or cannot be easily modified to support your apps [IT application]." (IT Manager, service sector)

In summary, the preceding discussions contend that possessing dynamic IT business transformation capability enables the combination and assimilation of IT-enabled competence and IT infrastructure competence. This blended operational IT competence empowers persistent IT application renewal and integration with diverse business functions to address environmental shifts. The underpinning lies in an adaptable infrastructure that can be readily modified and re-oriented as organisational priorities evolve. Thus, we propose:

> *Proposition 8: The capability of firms to effectively combine and assimilate IT-enabled competence and IT infrastructure competence can be aptly described as dynamic IT business transformation capability.*

By synthesising the arguments above, we propose a three-fold classification of dynamic IT capabilities: dynamic IT opportunity-sensing capability; dynamic IT opportunity-seizing capability; and dynamic IT business transformation capability. Each category of dynamic IT capability represents an elevated level of proficiency that empowers firms to seamlessly integrate and assimilate diverse forms of operational IT competence, thereby securing a sustainable competitive advantage within a rapidly evolving business landscape. Thus, we propose:

> *Proposition 9: From the standpoint of dynamic capabilities, IT capabilities encompass dynamic IT opportunity-sensing capability, dynamic IT opportunity-seizing capability, and dynamic IT business transformation capability, enabling the amalgamation and assimilation of distinct pairs of operational IT competence—namely, IT infrastructure competence, IT information-processing competence, and IT-enabled competence—fostering the creation of sustainable competitive advantages for firms in an ever-evolving business environment.*

5. Discussion and Conclusion

5.1 Theoretical Implications

Our study has contributed to the literature on IT capabilities in several important ways. First, expanding upon our refinement of the concept (e.g., Drnevich & Croson, 2013; Feeny & Willcocks, 1998; Zhang *et al.*, 2013), our analysis identifies three essential layers that collectively contribute to a nuanced understanding of IT capabilities. At the foundational level, we elucidate that IT capabilities encompass a diverse spectrum of valuable, rare, and inimitable IT-related assets (Aral & Weill, 2007; Byrd & Turner, 2000; Saunders & Brynjolfsson, 2016). This includes IT infrastructure, IT informational resources, and IT-enabled assets, collectively forming the foundational basis upon which firms' IT prowess is established.

Moving beyond the foundational layer, our study emphasises the practical manifestation of IT capabilities, highlighting the importance of competence in effectively organising and leveraging these IT-related assets. Operational IT competence emerges as a critical component, facilitating the adept mobilisation and deployment of IT-related assets (Byrd & Turner, 2000;

Dewett & Jones, 2001; Gerow *et al.*, 2015) through performing specific value-creating activities (see Table 1). We identify three distinct forms of operational IT competence—namely, IT infrastructure competence (encompassing IT infrastructure flexibility competence and IT infrastructure-business alignment competence); IT information-processing competence (encompassing IT information management competence and IT information sensemaking competence); and IT-enabled competence (encompassing IT exploitation competence and IT exploration competence). This layer underscores the significance of possessing not only valuable IT-related assets but also the competence to utilise and coordinate them strategically in alignment with organisational objectives.

Further ascending the conceptual hierarchy, our study unveils dynamic IT capabilities, signifying firms' capacity to reconfigure and assimilate various operational IT competences dynamically (Li & Chan, 2019; Lim *et al.*, 2011). Within this layer, we categorise three types of dynamic IT capabilities: dynamic IT opportunities-sensing capability, dynamic IT opportunities-seizing capability, and dynamic IT business transformation capability. This layer underscores the adaptive nature of IT capabilities, acknowledging that, in a fast-paced and ever-evolving business landscape, the ability to respond flexibly to changes and assimilate new competences is crucial for sustaining a competitive advantage. Our contribution lies in clarifying the multifaceted nature of IT capabilities, transcending the fragmented discussions prevalent across different research domains.

Second, in investigating the interconnected layers of IT capabilities (Aral & Weill, 2007; Li & Chan, 2019; Ravichandran & Lertwongsatien, 2005), we discern that each facet plays a pivotal role in shaping a comprehensive understanding of firms' prowess in IT. Beginning with IT infrastructure assets, these represent substantial investments directed toward enabling IT applications and functionality within the organisational context. The possession of IT infrastructure competence equips firms with the capacity to explore diverse strategies for

manipulating these assets, seamlessly integrating them into business operations to achieve strategic objectives. IT informational assets are the information generated or disseminated through information systems. These assets encapsulate critical aspects of firms' responsiveness, control, reliability, and adaptability. The possession of IT informational-processing competence becomes paramount in this context, enabling firms to effectively manage the influx of information derived from information systems. It empowers them to make sense of market occurrences with commendable accuracy, thereby enhancing decision-making processes. Transitioning to IT-enabled assets, we encounter tangible or intangible resources that, when integrated with information systems, serve as the bedrock of business operations, creating tangible value for the firm. Possession of IT-enabled competence becomes instrumental, allowing firms not only to adapt and enhance existing IT applications but also to explore novel applications. This adaptability is vital for augmenting the value derived from IT-enabled assets, thereby fostering revenue generation and improving overall profitability.

The amalgamation of IT infrastructure competence and IT informational-processing competence gives rise to dynamic IT opportunity-sensing capability. This capability enables firms to plan the construction and modification of IT infrastructure strategically. The goal is to facilitate information generation, dissemination, and interpretation, empowering firms to identify and capitalise on IT-related business opportunities strategically. The fusion of IT informational-processing competence and IT-enabled competence begets dynamic IT opportunity-seizing capability. This capability empowers firms to enhance cross-unit information flows, reinforcing integration between firm IT applications and other organisational assets (IT-enabled assets). This synergy becomes particularly crucial when capitalising on emerging business opportunities, ensuring a cohesive and streamlined approach. The combination of IT-enabled competence and IT infrastructure competence results in dynamic IT business transformation capability. This capability allows firms to reconfigure and

rejuvenate their IT infrastructure continuously. The aim is to maintain adaptive responsiveness, ensuring resilience in the face of rapid market shifts and technological advancements. Collectively, these interconnected layers form a cohesive and intricate framework, providing a comprehensive picture of the nature of firms' IT capabilities (Figure 1). This framework not only contributes to academic discourse about IT capabilities but also offers practical insights for navigating the dynamic landscape of IT within the business context.

Finally, our work advances the application of the RBT in elucidating firms' IT capabilities. Previous studies have extensively employed the RBT as a theoretical foundation for examining IT capabilities (Bharadwaj, 2000; Lioukas *et al.*, 2016; Wade & Hulland, 2004). However, RBT complexity stems from identifying organisational "resources" (Barney *et al.*, 2001; Fiol, 1991; Helfat & Winter, 2011; Ray *et al.*, 2004). Various elements, such as assets, human capital, processes, and knowledge, are considered resources when exploring IT capabilities, leading to fragmented discourse across domains. In alignment with the RBT, we have categorised resources into three classifications: assets, competence, and dynamic capabilities. By leveraging these classes, we have identified different layers of IT capabilities. Furthermore, based on the interconnectivity across RBT resource classifications (Amit & Schoemaker, 1993; Barney *et al.*, 2001; Helfat & Winter, 2011), we have illuminated the relationships among the layers of IT capabilities. This multifaceted RBT analysis unveils a comprehensive understanding of IT capabilities. Specifically, it reveals how the configuration and reconfiguration of assets, competence, and dynamic capabilities enable firms to translate IT investments into strategic outcomes. Our study pioneers new conceptual clarity regarding different RBT classifications through which resilient IT capabilities take shape within firms. This multifaceted RBT expansion fully comprehends the interdependent infrastructure, skills, and change processes driving productive IT investment across turbulent business landscapes.

5.2 Managerial implications

Our multi-layered perspective on IT capabilities offers valuable insights for managers seeking to leverage IT for competitive advantage. Fundamentally, managers must recognise their firms' collective IT-related assets, including IT infrastructure, IT informational, and IT-enabled assets. Strategic modernisation and expansion of these assets are essential. However, IT-related asset accumulation alone is insufficient. Managers must develop competence to mobilise and deploy them by performing specific value-creating activities effectively. This requires nurturing skilled infrastructure flexibility, information management and sensemaking, and mastery of IT-enabled business processes.

Additionally, managers must build dynamic capabilities to reconfigure IT competence rapidly amid changing conditions. Sensing and seizing IT opportunities and transforming business processes through IT require agility. Managers should emphasise scanning for innovations, enabling adaptable information flows and continuous IT-driven evolution. Fostering an IT–business aligned culture across the organisation can aid this. Cross-functional collaboration, staff rotation, and integrated planning enable alignment. Moreover, upskilling employees on emerging technologies and providing IT talent development pathways are critical. By recognising IT capability layers, embracing modernisation, building adaptive competence, and cultivating an IT-savvy workplace, managers can pursue comprehensive strategies for asset assembly, operational ability, and dynamic improvement cycles. This amplifies the power of IT as a differentiator.

Specifically, to mobilise IT infrastructure assets, managers must build operational IT competence in flexibility and alignment. Managers must also build operational IT competence in information management and sensemaking to mobilise IT informational assets. To mobilise IT-enabled assets, managers need to build operational IT competence in exploitation and exploration. Focusing firms' investment on acquiring and developing particular assets and

competence is prudent. However, unlocking dynamic capabilities requires possessing all asset types and competances. Only then can firms realise the full potential of IT investment. Our research provides a blueprint for managers leveraging IT for enduring competitive advantage.

6. Limitations and future research

As with all research, this study has limitations that provide opportunities for further exploration. First, our theory requires quantitative validation. Future researchers could collect large-scale, cross-industry survey data to validate our ideas empirically. Second, our informant sample was limited to four industries and weighted towards IT executives. Expanding input from other contexts like manufacturing may reveal additional insights. Moreover, while we reviewed seminal IT capabilities literature rooted in the RBT, incorporating perspectives from other theories could yield a more unified conceptualisation. Third, our identification of IT capability layers and their interconnections suggests possibilities for measurement development and factorial analyses. Scholars could construct holistic evaluations of organisational IT capabilities based on our model. Testing factors that strengthen or weaken the linkages between layers would also expand understanding.

Finally, applying our multi-theoretical lens approach to related IT phenomena like alliance and inter-firm collaboration may offer more cohesive pictures of their nature. Overall, quantitative validation, expanded informant diversity, theoretical integration, comprehensive measurement, factor analysis of connections, and extensions into adjacent spaces represent fruitful avenues for advancing this research stream. Testing and refining our ideas empirically while unifying perspectives can deepen insights into the multilayered essence of organisational IT capabilities.

Declarations

Availability of data and material
Data and material will be provided on request.

Competing interests
There are no conflicts of interest to declare.

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Authors' contributions
The study's conceptual idea was developed by Prof. Steve Chen. The data were collected by Prof. Steve Chen. The writing and editing of the paper were equally divided and completed by Prof. Steve Chen, Prof. Gordon Liu, Prof. Gelareh Roushan, and Prof. Bang Nguyen.

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Figure 1: Integrated Framework of IT Capabilities

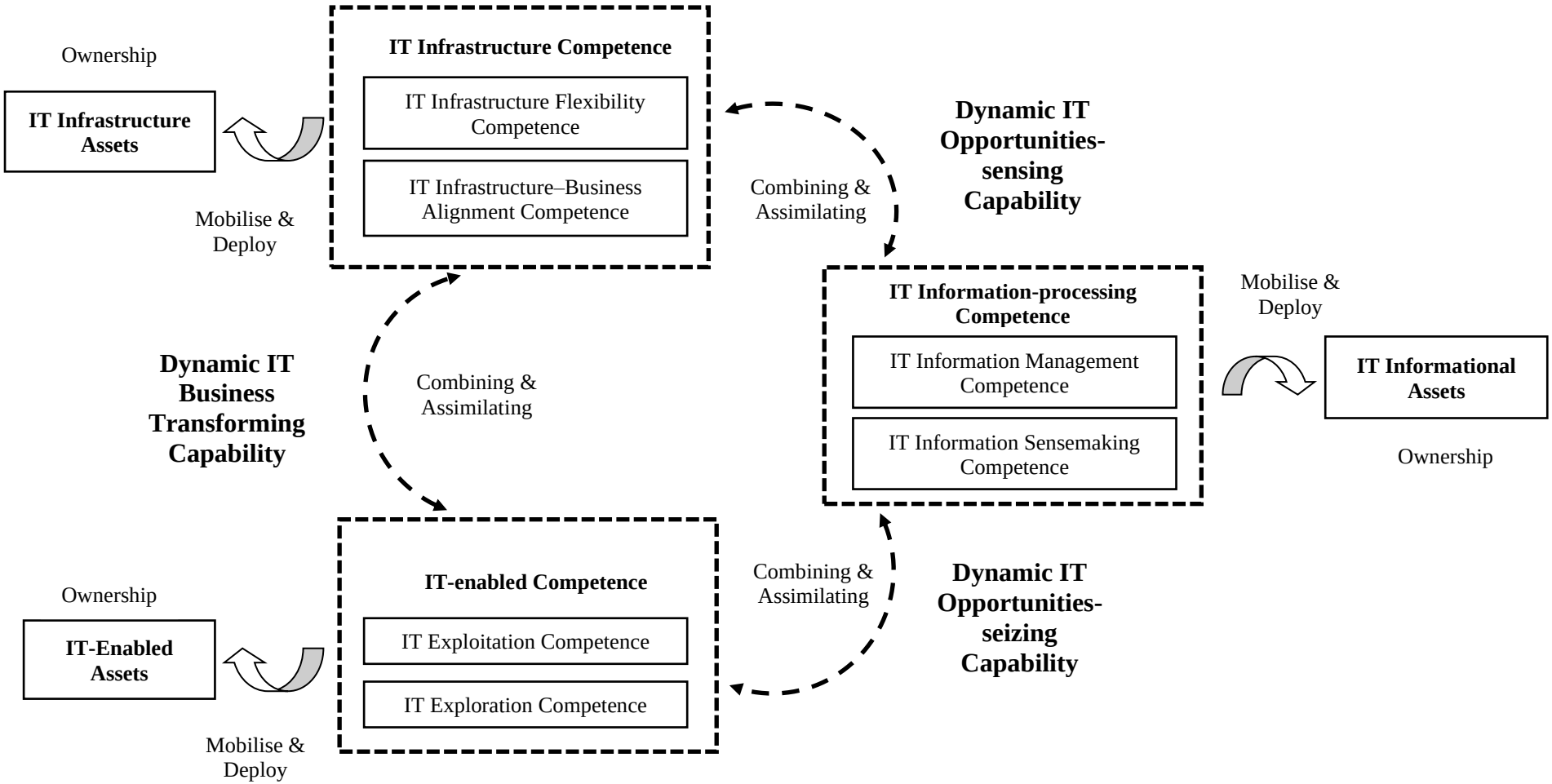

Table 1: Data Structure— Operational IT Competence

First-Order Categories: *A combination of Functional Routines (FR), Practical Know-How (PKH), and Conductive Organisational Culture (COC)*	**Second-Order Themes:** *Value-Creating Activities*	**Aggregate Theoretical Dimensions**
• Searching and promoting different approaches to manipulating the IT infrastructure (FR). • Knowledge on different applications of the IT infrastructure (PKH). • Encouraging and rewarding staff to try out new IT approaches to finding solutions (COC).	Unveiling innovative IT tactics	IT infrastructure flexibility competence
• Designing and building an IT infrastructure to ensure the flexibility of the technical components (FR). • Training on the technical and managerial skills in adding, modifying, and removing IT infrastructures to meet new market demands (PKH). • Facilitating ideas sharing across business units by establishing regular formal and informal gatherings (COC).	Engineering adaptable infrastructure solutions	
• Ensuring system reliability to support different IT approaches to finding solutions (FR). • IT system development expertise (PKH). • Establishing a communication platform across business units to share information on different IT applications (COC).	Fortifying systemic reliability	
• Identifying current and future customers' needs to form a clear business objective (FR). • Designing and building the firm's IT infrastructure to meet target customers' current and future needs (FR). • Knowledge about finding out customers' needs (PKH). • Firm-specific knowledge on business operations and IT applications (PKH). • Establishing organisation-wide hiring and purchasing guidelines (COC).	IT design for customer goals	IT infrastructure–business alignment competence
• Communication among different business departments and adjusting the IT infrastructure resources according to the business objective (FR). • Training in the technical and managerial skills required for linking IT investment and performance (PKH). • Communicating organisation-wide strategic aims and IT vision (COC). • Encouraging cross-departmental projects (COC).	Coordinating IT and business goals	
• Setting up data management (i.e., data collection, data entry, distribution, storage, and so on) guidelines (FR). • Tracking market changes and competitors' movements (FR). • Training on acquiring and managing information (PKH). • Database skills (PKH). • Organising cooperative data collection and sharing efforts (COC).	Establishing data management protocols	IT Information Management Competence
• Ensuring information security (FR). • Knowledge on information security (PKH). • Establishing an organisation-wide data management standard (COC).	Safeguarding information integrity	
• Tracking movements in the business environment (FR). • Knowledge of the general market conditions (PKH). • Knowledge of specific firm/industry practices (PKH). • Encouraging information sharing across business units (COC).	Business environment monitoring	IT Information Sense-Making Competence
• Developing a data analysis model to organise and process information and ensure speed and accuracy (FR). • Data analysis skills (PKH). • Data interpretation skills (PKH). • Developing communities within the organisation to share the data analysis and result interpretation experience (COC). • Developing a central data analysis department or functional unit (COC).	Data analysis model development	
• Generating inquiries and reports for specific scenarios (FR). • Scenario analysis skills (PKH). • Sharing reports across business units (COC).	Custom inquiry and reporting	

Table 1: Data Structure—Operational IT Competence (Continued)

First-Order Categories: *A combination of Functional Routines (FR), Practical Know-How (PKH), and Conductive Organisational Culture (COC)*	**Second-Order Themes:** *Value-Creating Activities*	**Aggregate Theoretical Dimensions**
• Identifying the current impacts of IT on a firm's business operations (FR). • Analysing part of the firm's existing functions that have not been, or at least not fully, integrated into the IT system (FR). • Knowledge of the different applications that can be performed on a firm's existing IT system (PKH). • An understanding of how to integrate different types of IT applications within a firm's operational processes (PKH). • Encourage staff to exploit the new potential of the firm's existing IT system (COC). • Coordinating idea sharing regarding the different ways of utilising IT among the business units (COC).	Evaluating IT strategic influence on operations	IT Exploitation Competence
• Designing and planning ways of using the firm's existing IT system to generate competitive value from the firm's existing resources (FR). • Training IT staff in various business operations (PKH). • IT system modification expertise (PKH). • Ensuring that all of the business units are comfortable about adopting IT in their operations (COC).	Orchestrating IT competitive strategy	
• Finding existing functions that can be improved by combining them with new IT applications, but not due to a lack of investment in IT (FR). • Training on updating the staff's knowledge on new IT functions and inventions (PKH). • Know-how about new IT development and the potential impact on the business operation (PKH). • Coordinating idea sharing about IT investment (COC). • Ensuring that all of the business units are comfortable with the new IT system and willing to integrate it into their business functions (COC).	Enhancing functions with new IT applications	IT Exploration Competence
• Searching for new business opportunities and innovation that can be generated through new IT investment (FR). • The knowledge to integrate new IT applications into a firm's operations (PKH). • Encouraging staff to explore new IT-driven business opportunities (COC).	Uncovering opportunities via new IT acquisitions	

Table 2: IT Infrastructure Flexibility Competence

Competence Forms	First-Order Categories	Additional Quotes
Functional Routines	• Searching and promoting different approaches to manipulating the IT infrastructure. • Designing and building an IT infrastructure to ensure the flexibility of the technical components. • Ensuring system reliability to support different IT approaches to finding solutions.	• Apart from providing training to the people familiar with the system, we also need a business application that is user-friendly. So, our less IT-knowledgeable employees can grasp the system quickly. It improves our flexibility when adopting a new system (Marketing Manager, retail sector). • […] we are not only trying to ensure that it [the IT infrastructure] is compatible, but also avoid purchasing IT equipment that can only serve one or two purposes. Occasionally, you will come across situations where you have to purchase specific equipment for a specific purpose. However, we rely on our engineering team to modify these to serve other purposes (Head of IT, retail sector). • We have to ensure that we can customise our system to meet the specific needs of different business units. To do so, we need to ensure that the system is designed so that it is reliable enough to allow us to use it with a flexible approach (IT Manager, financial sector).
Practical Know-How	• Knowledge on different applications of the IT infrastructure. • Training on the technical and managerial skills in adding, modifying, and removing IT infrastructures to meet new market demands. • IT system development expertise.	• The degree of flexibility regarding the IT-related resource is really about the people. The hardware and software cannot really do anything, if you do not have knowledgeable employees [both IT and non-IT employees] to put it into business use and adjust it accordingly if the market trend shifts. So, we need to organise training to give them new knowledge and information (Information Manager, IT sector). • Even IT specialists need to continue updating their knowledge. Therefore, if you want to increase the IT flexibility of your company, you need to be trained continuously (IT Manager, retail sector). • We have training constantly taking place in our organisation. It is because we are always updating or purchasing new technology to serve our clients better. So, we are constantly learning new skills (Director, financial sector).
Conducive Organisational Culture	• Encouraging and rewarding staff to try out new IT approaches to finding solutions. • Facilitating ideas sharing across business units by establishing regular formal and informal gatherings. • Establishing a communication platform across business units to share information on different IT applications.	• The company should be able to create an environment that allows people to try new things. […]. We ensure that they will receive a reward if the new ideas help the company to save money or generate new revenue (IT Manager, Financial Sector). • We have regular meetings with our colleagues [IT colleagues in different departments] to determine what they really want to deliver our services. […]. Once we agree, we ought to deliver that (Associate Director, financial sector). • Some projects require cooperation across departments or with external partners. If one party chooses to update their hardware and software, it usually require every partner to adopt this change quickly, in order to continue this project (System Manager, IT sector).

Table 3: IT Infrastructure–Business Alignment Competence

Competence Forms	First-Order Categories	Additional Quotes
Functional Routines	• Identifying current and future customers' needs to form a clear business objective. • Designing and building the firm's IT infrastructure to meet target customers' current and future needs. • Communication among different business departments and adjusting the IT infrastructure resources according to the business objective.	• IT capability for me is about how well an organisation's IT systems are set up to deal with the daily business operations, how these IT systems can serve our current business objective, as well as whether we have people who know how to operate them. […]. It is not just about writing a big cheque for an expensive purchase [of an IT system] or always going after the latest technology (CEO, retail sector). • It is about what the technology can do for us. […]. It is not about that, you have the latest technology. Sometimes, the old technology can be more suitable for the company in current business practice (Marketing Manager, retail sector).
Practical Know-How	• Knowledge about finding out customers' needs. • Firm-specific knowledge on business operations and IT applications. • Training in the technical and managerial skills required for linking IT investment and performance.	• The manager should have an understanding about what this hardware or software can do for a company and how should it be used in the business application (Chief Information Officer, retail sector). • IT technology needs to fit with the business operation. […] At the same time, we also need to build strong internal IT teams to help us to accomplish this (IT Manager, service sector). • Having the necessary hardware and software can enable firms' IT capability. More importantly, firms need to understand how to use this hardware and software to align them with the firm's business model. Therefore, the firm should hire IT technicians to explore this potential (Lecturer, UK higher education sector).
Conducive Organisational Culture	• Establishing organisation-wide hiring and purchasing guidelines. • Communicating organisation-wide strategic aims and IT vision. • Encouraging cross-departmental projects.	• We need to understand the individual business units' function and what they need [IT-related knowledge] to do their job property. At the same time, we need also to take a big overview about why this [IT] can help our business in general (Consultant, Financial sector). • […] everyone should be part of the team that designs this system. So, we can meet each of their needs and also the needs of the entire company. What we have done here is to establish a company-wide network platform to get everyone involved (IT Manager, financial sector). • We have published our IT strategy internally; therefore, everyone understands what kind of technology we are looking for and how should it connect to our business (IT Manager, service sector).

Table 4: IT Information Management Competence

Competence Forms	First-Order Categories	Additional Quotes
Functional Routines	• Setting up data management (i.e., data collection, data entry, distribution, storage, and so on) guidelines. • Tracking market changes and competitors' movements. • Ensuring information security.	• IT can generate and store more customer information that allows us to perform further analysis about the need of our customers. But, the key question here is where you plan to collect this information from and where you plan to store it. […], it will be helpful if the company gives clear instructions on such issues. You also need to ensure that the data you pass around can be analysed by the different departments. You need to ensure that everyone uses the same scale of measurement (IT Consultant, service sector). • It is important to make sure people can access the right information at the right time and also make sure the information is protected throughout this process (Marketing Manager, service sector). • It is not only important to transfer the right information to the right people, but also to ensure that the wrong people cannot access this information. In other words, we need also to pay attention to the security issue during the process of information sharing (Service Engineer, financial sector).
Practical Know-How	• Training on acquiring and managing information. • Database skills. • Knowledge on information security.	• Employees need to have a full understanding about where the information is and to whom it should be delivered. That is the focus on our training (Information Manager, financial sector). • Information security is also important for this task [managing information]. Engineers should have sufficient knowledge about information security (System Manager, IT sector). • My view is that organisations must make sure that their IT employees have a good understanding about how to search/collect information, where it will be stored and how it will be used for making business decisions. A good training program will help to achieve these goals (Service Manager, IT sector).
Conducive Organisational Culture	• Organising cooperative data collection and sharing efforts. • Establishing an organisation-wide data management standard.	• Information sharing is critical in enhancing our performance. You need to have the engineering side, supply side and the other sides of the business work together and carry out tasks. […]. In my opinion, it is also cheaper for us to share information around the company, than have individual departments allocate budgets to collect their own information (Director, financial sector). • We need to create a workplace environment where different departments of the company can supply the necessary information to each other on various projects (Marketing Manager, service sector).

Table 5: IT Information Sense-Making Competence

Competence Forms	First-Order Categories	Additional Quotes
Functional Routines	• Tracking movements in the business environment. • Developing a data analysis model to organise and process information and ensure speed and accuracy. • Generating inquiries and reports for specific scenarios.	• You cannot just analysis the data you've collected, because the results do not mean anything unless you have accounted for what happened externally in the marketplace, as well as the resources available internally. […] (IT Manager, retail sector). • The use of hardware and software to collect important information in the marketplace for me is very straightforward. […]. However, the way that we are making sense of the information generated from the IT system is much more important than gathering information (Marketing Manager, IT sector). • Someone proposes a project to the company. […]. The manager needs to use the information system to evaluate whether this project is doable. Sometimes, the information is random and overwhelming. You need to create mathematical and statistical models to find out what this information means. […]. The ultimate objective here is to come up with some scenarios for the executives to choose from. Otherwise, the data analysis is pointless (Senior Lecturer, UK higher education sector).
Practical Know-How	• Knowledge of the general market conditions. • Knowledge of specific firm/industry practices. • Data analysis skills. • Data interpretation skills. • Scenario analysis skills.	• It always comes down to the team efforts at understanding what the data mean. Therefore, it is really a test of the company's organisational skills to group these people together to share ideas and exchange insights on different interpretations. What we can do as a company is to set up many communities [both formal and informal] to encourage them to communicate with each other (IT Manager, service sector). • I think many companies still emphasise training people in how to use the hardware and software to collect and manage data. In my view, they should invest more in training the individual to make sense of information from the dataset (Marketing Manager, retail sector). • I would like the data collected from different business units to be stored in one place and analysed altogether. So, we are speaking about one truth. It also helps us to compare and identify the differences in our data (Service Manager, IT sector).
Conducive Organisational Culture	• Encouraging information sharing across business units. • Developing communities within the organisation to share the data analysis and result interpretation experience. • Developing a central data analysis department or functional unit. • Sharing reports across business units.	• I would like the data collected from different business units to be stored in one place and analysed altogether. Therefore, we are speaking about one truth. It also helps us to compare and identify the differences in our data. (Service Manager, IT sector) • When the information passes to the operation level, it is not usually just about one part of the business. It is usually about many parts of the operation, such as inventory and the ordering process. Therefore, different departments cannot just react for their own benefit. They also need to think how others react and change their approach accordingly (IT Manager, financial sector).

Table 6: IT Exploitation Competence

Competence Forms	First-Order Categories	Additional Quotes
Functional Routines	• Identifying the current impacts of IT on a firm's business operations. • Analysing part of the firm's existing functions that have not been, or at least not fully, integrated into the IT system. • Designing and planning ways of using the firm's existing IT system to generate competitive value from the firm's existing resources.	• Before you do anything [incorporating IT with existing business operation], you need to not only have the knowledge of how IT can improve the effectiveness and efficiency of business operation, but also have the awareness of what are the areas [i.e., customer service, quality control … etc.] in your business that be further improved by using or modifying the existing usage of IT (Product Manager, IT sector). • We can use IT to improve our business operation and make it better and more effective. That is nothing new for anybody but what we did differently here is that we always try to find out whether we have maximised our IT potential yet. We always ask ourselves whether, if we applied IT differently here, we could improve our business function to better serve our customers (Head of IT, financial sector). • If we know what areas [business functions—customer services, inventory management … etc.] that we want to improve, we can always redesign and modify our IT applications to solve these challenges (IT Manager, retailer sector).
Practical Know-How	• Knowledge of the different applications that can be performed on a firm's existing IT system. • An understanding of how to integrate different types of IT applications within a firm's operational processes. • Training IT staff in various business operations. • IT system modification expertise.	• We have different business training programmes for our IT staff, such as inventory control, pricing, customer services, and so on. We want them to be able to think about a better way to improve our business services (Head Manager, retail sector). • We study how our IT-related resources have supported parts of our business operations and what we should do to use our IT-related resources to support other parts of our business operation (IT Manager, service sector). • You need to provide necessary training to your employees about your company's IT resources. […]. You can invest all the money you want; if the employees don't know how to use them to create synergy and apply to different business functions, it will be a waste (HR Manager, IT sector).
Conducive Organisational Culture	• Encourage staff to exploit the new potential of the firm's existing IT system. • Coordinating idea sharing regarding the different ways of utilising IT among the business units. • Ensuring that all of the business units are comfortable about adopting IT in their operations.	• It is a joint effort among different parts of the company that enables us to exploit this [IT] potential. You can't have one department devoted to this notion and others that just wait and see. I think many companies did not invest enough money in their IT program to enable them to serve their existing business better. In other words, they only explore a little of their IT potential. (IT Manager, financial sector). • Meeting and brainstorming with our IT guy is a regular exercise in our company. […] We constantly ask questions about how to improve our business operation and our IT guy will work with us to design an IT-based solution in response to our requests (Service Manager, service sector). • The group that I work in has exploited all possible opportunities for using IT to improve our business operation. We usually cross-reference and bring a great idea from one part of the business to another part of the business (Engineer, IT sector).

Table 7: IT Exploration Competence

Competence Forms	First-Order Categories	Additional Quotes
Functional Routines	• Finding existing functions that can be improved by combining them with new IT applications, but not due to a lack of investment in IT. • Searching for new business opportunities and innovation that can be generated through new IT investment.	• When we purchase future IT-related products or software, we always ask ourselves whether it can add more [value] to our existing business applications. For example, we purchased a new mobile technology system that can help us to upgrade the performance of our customer service application (System Manager, IT sector). • In the last few years, our objective has been to find out how to use IT to facilitate the growth of the company. […]. I need to identify what our future business will be and how our IT resources can support that or what kind our system we need to acquire to achieve this goal (Marketing Manager, retail sector).
Practical Know-How	• Training on updating the staff's knowledge on new IT functions and inventions. • Know-how about new IT development and the potential impact on the business operation. • The knowledge to integrate new IT applications into a firm's operations.	• The company needs to be aware of any future trends about the business and how new technology can help to restore the technology gap between where the company is and where it's going to be in the future. […]. It is also equally important to ensure that, when the company acquires these new technologies, the employees have the necessary knowledge to fit them into our system (Software Developer, IT sector). • The company should provide training and keep updating the employees' knowledge on the latest technology available and try inspiring them to come up with new ideas for using these technologies to solve the problem that we are facing or combining the new technology with that we have right now (Head of IT, retail sector).
Conducive Organisational Culture	• Coordinating idea sharing about IT investment. • Ensuring that all of the business units are comfortable with the new IT system and willing to integrate it into their business functions. • Encouraging staff to explore new IT-driven business opportunities.	• We are encouraging our employees to come up with new ideas about using the latest technology and share their ideas with each other. If you are an employee of our company, you are expected to go to your supervisor anytime to describe to him/her what you are working on right now and how it can impact on the current technological stage of the company. We have invested in so many great and crazy ideas. Most of the projects will not see the light of day, but we just keep investing and trying new things (Product Manager, IT sector). • You need always to keep the employees informed about the leading-edge technology and hope that they will come up with the idea of integrating them into our current IT resource. At the same time, you also need to ensure that they are comfortable about engaging with new technology. I think you will be kind of surprised about how many people do not really like to try something new (Marketing Manager, IT sector).

Appendix 1: Informants

Industry	Job Title	Job Functions
IT Sector	Application Manager	Research and development
	Engineering	Research and development
	HR Manager	Staff recruitment
	Information Manager	Date management
	IT Consultancy	IT service advisory
	IT Manager	Research and development
	IT Officer	Developing software product
	IT Specialist	Data management
	IT Technician	Solving IT-related challenges
	Managing Director	Overseeing all European operations
	Marketing Manager	Sales and services
	Marketing Manager	Sales and marketing
	Product Manager	New Product development
	Product Manager	Research and Development
	Service Executive	Overseeing IT service delivery
	Service Manager	Problem solving and client solutions
	Service Manager	Client consultancy
	Software Developer	Customisation software for clients
	System Manager	System maintenances
	Technical Architect	Research and development
	IT Manager	IT service management
Retail Sector	CEO	Managing the company
	Chief Information Officer	IT infrastructure development
	Head Manager	Marketing strategy design
	Head of IT	IT strategy management
	Information Officer	Data management
	IT Manager	System maintenances
	IT Manager	Online system operation
	Managing Director	Overseeing business operation
	Marketing Manager	Advertising
	Marketing Manager	Client management
	Marketing Manager	Supply chain management
	Marketing Manager	Advertising and customer service
	Service Manager	Customer service management
	Learning solution specialist	IT product and service development
Financial Sector	Associate Director	Oversee business operation
	Consultant	Online Financial advise
	Consultant	Financial analysis
	Director	Overseeing business operation
	Financial Analysis	Financial market analysis
	Head of IT	IT and e-commerce strategy
	Information Manager	Data management
	IT Manager	System maintenances
	IT Manager	Website service maintenance
	Marketing Manager	Customer relationship management
	Service Engineer	Online service maintenances
	Service Manager	Customer service management
	Supervisor	Overseeing relationship management operation
	Head of IT.	Operation consultancy
	Information Officer	Data analysis
	Consultant	Financial investment
Service Sector	IT Architect	Online system maintenance
	IT Consultant	Online system development
	IT Manager	Service system development
	IT Manager	Online product testing
	IT Manager	IT system maintenances
	Marketing Manager	Product development
	Marketing Manager	Customer relations
	Service Manager	Relationship management
	Assistant IT director	Developing and maintaining University IT system

Academic Researchers	Deputy Head of Department	Delivery university lecture and IT consultancy
	Head of Department	Delivery university lecturer
	Lecturer	Delivery university lecturer
	Senior Lecturer	Delivery university lecturer

Appendix 2: Interview Questions

Stages	Sample Questions
1	• Could you give an introduction to your background and experience in relation to IT? • Could you give an introduction about your involvement in IT-related projects? • What are your managerial role and responsibilities in your company related to IT?*
2	• What does IT capability mean, at a personal and organisational level? • What is the IT requirement in your organisation to achieve IT capability at a higher level? • What kinds of business operations do IT-oriented companies perform? • Which organisational factors might encourage or discourage the level of IT capability? • How would you measure IT capability in the organisation? • How does IT create business opportunities for your organisation? • Has your organisation's IT capability evaluation changed in the past and will it change again in the future?

Note:
***** This question was not posed to the four academic informants.

Appendix 3: Data Analysis and Codes

RBT Resource Classification	Coding Focus	Codes Example
IT-Related Assets	The respondents' commentary regarding their considerations when assessing the types of tangible and intangible IT-related resources possessed by the company.	Equipment; Software; Information access via IT; Networks; Communication via IT; IT support; IT-business synergy; IT investment; etc.
Operational IT Competence	The responses provided by the participants concerning their perspectives on evaluating the operational processes facilitating the mobilisation and deployment of firms' assets related to IT.	Operation manual, Guidelines, Processes, Work procedures, Protocols, etc.
	The responses provided by the participants concerning their perspectives on evaluating the knowledge and skills facilitating the mobilisation and deployment of firms' assets related to IT.	Knowledge; Skills; Expertise, How-to; Know-how; Understanding; Idea; etc.
	The responses provided by the participants concerning their perspectives on evaluating the organisational culture facilitating the mobilisation and deployment of firms' assets related to IT.	Norms; Culture; Rules , Environment; Climate; General agreements; Shared value, Shared beliefs, etc.
Dynamic IT Capabilities	The respondents articulated their perspectives on the firms' capacity to cultivate new competence through the assimilation of existing competence. This process enables the firms to effectively mobilise and deploy assets associated with IT.	Planning; Learning, Adaptive; Environment scan; Responsiveness; Resilience, Developing, Design, Create; Combine; Integrate; Modify; Realignment; Strategic change, etc.