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Empowering SMEs Through Managerial Engagement in the Digital Economy: A Job Demands-Resources Approach

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Empowering SMEs Through Managerial Engagement in the Digital Economy: A Job Demands-Resources Approach

Jesus Juyumaya

EXECUTIVE SUMMARY

Small and medium-sized enterprises (SMEs) are central to employment, innovation and inclusive growth across Asia-Pacific Economic Cooperation (APEC) economies, yet their digital transformation remains uneven amid increasing technological complexity and global uncertainty.

While prior research has primarily focused on employees or technological adoption, the role of managers, who orchestrate and sustain digital initiatives, remains under-explored. This paper develops a conceptual framework to explain how managerial work engagement enables effective digital transformation and performance in SMEs.

Drawing on the job demands-resources (JD-R) theory, digital transformation is conceptualized as a set of managerial tasks shaped by emerging job demands (e.g., sustained attention, timely responsiveness and cognitive overload), job resources (e.g., big data, artificial intelligence and automation) and personal resources (e.g., technological reflectiveness and individual ambidexterity).

The study advances four novel research propositions linking these digital job characteristics to managers' work engagement and, subsequently, to task performance in digital adoption and digital business-model innovation. It positions work engagement as a central mechanism through which managers translate digital resources into organizational outcomes. By integrating insights from organizational behaviour, strategic management and digital transformation, this paper contributes a manager-centred and human-centred perspective on SME digitalization. It offers a foundation for future empirical research and provides practical implications for policymakers and organizations seeking to foster inclusive and sustainable digital transformation.

The contribution is deliberately conceptual: the paper develops a theoretical framework and a set of testable propositions rather than empirical findings, and it identifies the empirical validation of these propositions as a priority for future research.

Future studies can test and refine the proposals across different SME contexts, sectors and APEC economies using quantitative, qualitative and mixed-method approaches. The framework allows researchers to study how managers' engagement with their work contributes to digital adoption and business-model innovation, and to the long-term sustainability of SMEs that are embracing a digital transformation.

INTRODUCTION

Small and medium-sized enterprises (SMEs) constitute the backbone of employment generation, innovation and inclusive growth across Asia-Pacific Economic Cooperation (APEC) economies. Despite their strategic importance, SMEs continue to experience highly uneven patterns of digital transformation, reflecting persistent differences in managerial capabilities, access to digital infrastructure, financial resources, technological readiness and the increasing complexity of emerging digital technologies. These challenges have become even more pronounced in an environment characterized by rapid technological change, global uncertainty and growing sustainability pressures. Although prior research has predominantly examined digital transformation from the perspectives of technology adoption or employee outcomes, considerably less attention has been devoted to the role of managers, despite their central responsibility for interpreting, orchestrating, sustaining and scaling digital transformation initiatives within resource-constrained organizations. This gap is particularly important in SMEs, where managers often concentrate strategic, operational and innovation responsibilities, making their decisions and engagement critical to successful digital transformation. Understanding how managers experience, interpret and navigate the new demands and resources associated with digital transformation is therefore essential not only for strengthening SME resilience and competitiveness, but also for informing policies aimed at promoting inclusive and sustainable digital development across APEC economies.

This unevenness is well documented. Across APEC economies, micro, small and medium enterprises (MSMEs) account for the majority of businesses and over half of regional employment, yet they generate a comparatively small share of direct exports, reflecting persistent gaps in scale and capability (APEC 2024). Cross-country evidence further shows that digital gaps between small and large firms are relatively narrow for basic uses of technology, such as online sales, social media or electronic invoicing, but widen substantially for more sophisticated applications such as data analytics, cloud computing and enterprise-wide digital integration (OECD 2021). MSMEs also continue to report constrained access to financing, digital infrastructure and managerial skills relative to larger firms, which limits their ability to translate digital tools into performance gains (OECD 2023).

These patterns motivate the present focus on managers as the actors who must interpret and deploy digital resources under constrained organizational capacity.

Technological innovations are rapidly reshaping the way managers perceive markets, make strategic decisions and interact with increasingly complex human-machine systems (Hsieh and Vergne 2022). Digitalization, understood as the use of digital technologies to transform business models and generate new value-creating resources (Annarelli et al. 2021), is fundamentally redefining the nature of managerial work. Digital businesses built around platforms, big data, machine learning, robotics, artificial intelligence (AI), metaverse applications and algorithmic decision systems increasingly reshape how organizations process information, co-ordinate activities and allocate managerial attention (Sidner et al. 2005; Brougham and Haar 2018; Sohn and Kwon 2020). While these technologies automate repetitive or cognitively demanding activities, they simultaneously relocate managers' work toward more complex responsibilities involving data-driven judgment, continuous monitoring of digital infrastructures, strategic interpretation of algorithmic outputs and high-stakes decision-making under uncertainty (Demerouti 2022). Consequently, digital transformation should be understood not only as a technological process but also as a profound transformation of managerial work itself. For example, big data expand organizational intelligence by generating large volumes of information, whereas AI systems classify and analyze these data far more efficiently than human analysts through predictive analytics, fundamentally changing how managers acquire, interpret and use information in decision-making.

These developments highlight the need for organizational behaviour and strategic management research to better understand how digital transformation reshapes managerial work through new job demands, job resources and personal resources. Although previous research has extensively examined digital technologies and employee outcomes, considerably less attention has been devoted to understanding how managers experience the psychological and cognitive consequences of digital transformation, particularly within SMEs operating under significant resource constraints. As a result, there remains limited theoretical agreement regarding how digital transformation modifies the architecture of managerial work and how these changes influence managerial work engagement.

The job demands-resources (JD-R) model offers a valuable theoretical lens for understanding how job resources help individuals achieve work goals, reduce the psychological and physiological costs associated with job demands and stimulate learning and development (Bakker and Demerouti 2017). However, the rapid evolution of digital infrastructures raises new questions as to whether emerging digital technologies consistently function as job resources or whether, under certain organizational conditions, they may also create additional job demands that influence managers' vigour, dedication and absorption (Demerouti 2022; Schaufeli and Bakker 2010).

Digital managerial work increasingly requires sustained cognitive vigilance. Demerouti (2022) argues that these tasks demand continuous attention and timely responses to rapidly changing visual and informational stimuli. Decision-support systems such as dashboards and dynamically updated balanced scorecards provide managers with real-time indicators of organizational performance. Yet managers do not respond uniformly to these digital environments. Some interpret rapidly changing information as challenging and motivating, responding with greater vigour and engagement (Torres et al. 2017), whereas others experience cognitive overload, decision fatigue or burnout when confronted with continuous streams of information and increasing monitoring responsibilities. Moreover, digital transformation requires continuous learning and the ongoing acquisition of new technological competencies (Meijerink et al. 2021), frequently increasing workload, pressure and psychological fatigue (Andrade-Valbuena and Torres 2018). These contrasting responses suggest that digital technologies cannot be understood as inherently beneficial or detrimental. Rather, their influence depends on the extent to which digital job demands are balanced by adequate job resources and personal resources. Managers therefore require new capabilities, such as technological reflectiveness and individual ambidexterity, to successfully navigate increasingly complex digital environments.

Despite these developments, existing research has predominantly examined the consequences of job demands and resources at the employee level, while giving comparatively little attention to the distinctive characteristics of digital managerial work or to the mechanisms through which managers become engaged in digital transformation initiatives. This gap is particularly evident within SMEs, where managers simultaneously perform strategic, operational and entrepreneurial roles with limited financial, technological and human resources. Consequently, a coherent theoretical explanation of how digital transformation reshapes managerial work — and under which conditions emerging digital technologies function as job demands, job resources or both — remains largely absent.

To address this gap, this paper develops a conceptual framework grounded in the JD-R model to explain how SME managers perceive, interpret and respond to the job demands, job resources and personal resources embedded in digital managerial tasks.

Building on, but moving beyond, previous conceptual work on digital managerial engagement, the framework is explicitly developed for SMEs operating within the policy context of APEC economies, where resource constraints, uneven digital maturity and institutional heterogeneity shape the managerial experience of digital transformation. Rather than treating digital technologies as inherently positive organizational resources, the proposed framework emphasizes the conditions under which they may either facilitate or hinder managerial work engagement.

This paper argues that digital business models introduce distinctive managerial tasks and contextual conditions that influence work engagement and, consequently, managers' performance in digital adoption, digital business-model innovation and organizational resilience. Accordingly, this study addresses two central research questions: 1) What digital job demands, job resources and personal resources shape managers' work engagement in SME digital transformation? and 2) What are the implications of this framework for future research and for policies supporting SME digital transformation across APEC economies?

To answer these questions, this paper advances four theoretical propositions. First, managerial work engagement is expected to enhance task performance in digital adoption and digital business-model development (Proposition 1). Second, sustained attention, timely responsiveness and maintenance and deployment activities are proposed as distinctive digital job demands whose effects on engagement depend on the availability of adequate job and personal resources (Proposition 2). Third, big data, artificial intelligence and automation are conceptualized as digital job resources that support managerial functioning under appropriate organizational conditions but may also become sources of additional demands when autonomy, training, usability or organizational support are insufficient (Proposition 3). Fourth, technological reflectiveness and individual ambidexterity are proposed as key personal resources that strengthen managers' capacity to navigate digital transformation within resource-constrained SMEs (Proposition 4). Together, these propositions provide a human-centred conceptual framework for understanding managerial work in digitally transforming SMEs while establishing a foundation for future empirical research, including cross-economy and mixed-methods studies capable of capturing the diversity of SMEs across APEC economies.

Consistent with this aim, the paper is conceptual rather than empirical: its contribution is a theoretical framework and a set of testable propositions, and the empirical validation of these propositions is identified as a priority for future research, as discussed in Section 5.4. By integrating insights from organizational behaviour, strategic management and digital transformation research, this paper develops a human-centred conceptual framework that explains how managerial work engagement shapes digital transformation within SMEs. It extends the JD-R model's application to the distinctive managerial realities of SMEs operating in APEC economies, where resource constraints, heterogeneous levels of digital maturity and institutional diversity influence the implementation of digital transformation initiatives.

Beyond its theoretical contribution, the framework offers a policy-oriented perspective by identifying how managerial work engagement can be strengthened through organizational practices and targeted public policies. Accordingly, the model provides practical guidance for policymakers seeking to design more inclusive and human-centred digital strategies, managerial capability development programs, SME support initiatives and collaborative digital ecosystems that place managerial work engagement at the centre of sustainable, resilient and inclusive digital transformation across APEC economies.

This paper makes a contribution that is distinct from Juyumaya and Torres (2023), who propose a general framework of managers' work engagement in digital tasks at the level of managers broadly, developed from an organizational behaviour perspective. The paper departs from that framework in three respects. First, it is deliberately centred on SMEs, a setting characterized by resource constraints, ownership structures and managerial spans of control that were not the object of the earlier framework. Second, it explicitly situates the JD-R logic within the APEC digital policy agenda, translating it into implications for policymakers and SME support agencies, a purpose absent from the earlier study. Third, the four propositions advanced here are reformulated specifically for SME managers operating under constrained job and personal resources, rather than for managers in general. The paper builds on constructs discussed in Juyumaya and Torres (2023), most notably the distinction between digital adoption tasks and digital business-model tasks adapted in Table 1, but its contribution lies in relocating and reworking these constructs for the SME and APEC policy context that the earlier paper does not address.

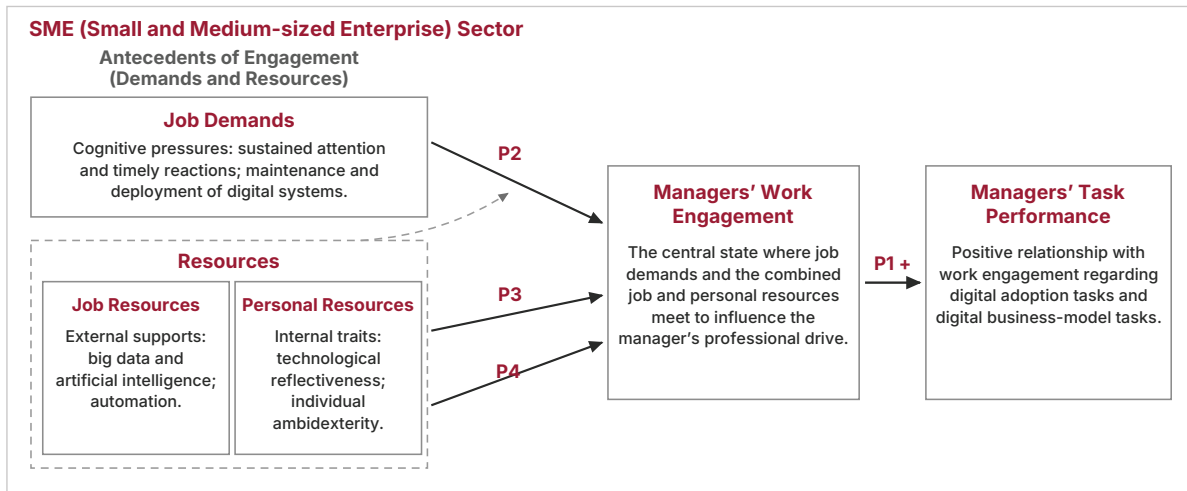
WORK ENGAGEMENT IN DIGITAL MANAGERIAL TASKS

Typically, the JD-R model has been used to predict some positive organizational effects of traditional jobs on employees, such as motivation, organizational commitment, work engagement and task performance (Schaufeli and Salanova 2007; Juyumaya 2022), juxtaposed to adverse organizational outcomes, like stress, exhaustion, burnout, sickness, absenteeism (Schaufeli et al. 2008; Breevaart et al. 2015). The JD-R model analyzes job characteristics in two categories: demands and resources. Job demands refer to the physical, psychological, social or organizational aspects that require physical and psychological effort and are related to physiological and psychological costs, such as work pressure and emotionally demanding interactions with board members, strategic partners and clients (Burke and El-Kot 2010). On the other hand, job resources refer to the physical, psychological, social or organizational aspects of the job that are a) functional in achieving work goals; b) reducing job demands and the associated physiological and psychological costs; or c) stimulating personal growth, learning, and development (Bakker et al. 2011).

Figure 1 outlines the four propositions within the work engagement framework for digital managerial tasks. It is based on the JD-R model (Bakker and Demerouti 2017). This framework explores four research propositions about the role of managers' digital tasks within the work engagement framework. It suggests how new job demands and resources could be further explored concerning managers' digital tasks. The framework's left side depicts new job demands (sustained attention and timely reactions, and maintenance and deployment), new job resources (big data and artificial intelligence, and automation) and new personal resources (technological reflectiveness and individual ambidexterity). The right half of the framework illustrates the results of managers' work engagement. It concerns the impact of job demands and resources on task performance (digital adoption tasks and digital business-model tasks), following an individual level of analysis.



Figure 1. A Conceptual Framework of SME Manager Performance in the Digital Economy



Note: Adapted from Bakker and Demerouti (2017). Solid arrows indicate direct relationships; the dashed arrow indicates the buffering and amplifying effects of job and personal resources on the relationship between job demands and work engagement.

It is worth clarifying how this application of the JD-R model relates to Juyumaya and Torres (2023), who examine managers' work engagement in digital tasks in general organizational settings. This paper adapts the same underlying theory to a different unit of analysis and purpose: it focuses specifically on SME managers, who face distinctive constraints in job and personal resources relative to managers in larger organizations, and it links the resulting framework to the APEC digital policy agenda rather than to organizational behaviour theory alone. The two papers therefore share a theoretical foundation while pursuing different research questions and audiences.

EFFECTS OF DIGITAL MANAGERIAL TASKS ON MANAGERS' WORK ENGAGEMENT

Creating, implementing and sustaining digital technologies has become a permanent managerial responsibility within SMEs. Rather than representing isolated technology implementation projects, digital adoption constitutes an ongoing managerial task that requires managers to continuously interpret, evaluate, integrate and adapt digital technologies to organizational needs. These activities expose managers to new job demands while simultaneously providing access to new job resources that shape their work engagement. Following Juyumaya and Torres (2023), this paper distinguishes between two complementary digital managerial tasks embedded within the proposed work engagement framework: 1) digital adoption and 2) digital business-model development. Although these tasks build on the conceptual distinction introduced by Juyumaya and Torres (2023), the present framework examines them specifically within the context of SMEs, where limited financial, technological and human resources substantially influence how managers experience digital transformation.

Digital adoption occurs when managers acquire, implement and effectively use digital technologies to achieve organizational objectives. Successfully managing digital adoption requires managers to: a) recognize the strategic potential of digital resources; b) accept and integrate those resources into existing organizational processes; and c) deploy digital

technologies to improve operational efficiency, decision-making and innovation. As organizations increasingly automate standardized and routine activities, managerial work shifts away from direct task execution toward supervising digital systems, interpreting digital information and co-ordinating increasingly complex organizational processes. Consequently, automation reduces the active use of routine cognitive skills while increasing managers' responsibilities for monitoring digital systems and responding to rapidly changing information (Parker and Grote 2022).

Digital adoption also requires managers to integrate information originating from multiple technological and organizational sources. However, digital data create value only when they are effectively combined, interpreted and translated into actionable managerial knowledge. Information silos remain a major organizational challenge, particularly within SMEs, where limited digital capabilities frequently hinder effective integration of dispersed information. To address this challenge, managers must oversee increasingly complex data management processes. Zhan and Tan (2020) propose an analytical framework of five stages for transforming data into managerial knowledge: 1) data capture and management; 2) data cleaning and integration; 3) data analytics; 4) competence-set analysis through deduction graphs; and 5) information interpretation and decision-making.

Digital adoption requires managers to remain actively engaged throughout each of these stages. During data capture and management, managers must determine which sources of information should be collected to maximize organizational value. During data cleaning and integration, they are responsible for classifying, validating and integrating information originating from multiple digital systems. During the analytics stage, managers supervise the application of analytical and data-mining techniques to identify relevant organizational knowledge. Subsequently, they interpret analytical outputs through competence-set analysis before translating those insights into strategic and operational decisions.

From the perspective of the JD-R model, these activities substantially increase the cognitive complexity of managerial work. Digital adoption requires managers to sustain attention over prolonged periods, respond rapidly to continuously changing information, supervise digital infrastructures and co-ordinate the deployment and maintenance of digital systems. These digital job demands may become significant sources of cognitive overload when they are not supported by adequate job and personal resources. Conversely, managers who experience high levels of vigour, dedication and absorption are more capable of interpreting digital information, integrating new technologies into organizational processes and promoting digital innovation within their organizations (Demerouti 2022). Accordingly, managerial work engagement is proposed as a central mechanism through which SMEs successfully adopt and implement digital technologies despite operating under resource constraints.

DIGITAL BUSINESS-MODEL TASKS

Technological innovation alone does not guarantee sustainable competitive advantage. Although new products and services can often be imitated, business-model innovation enables organizations to create, deliver and capture value in ways that are considerably more difficult for competitors to replicate. Consequently, successful digital transformation requires that technological innovation be accompanied by business models capable of translating digital capabilities into sustainable sources of competitive advantage. As Johnson et al. (2008) argue, business models can reshape industries and drive exceptional organizational growth. This perspective has generated increasing interest in business-model innovation within both research and managerial practice, particularly as digital and platform-based economies increasingly rely on software, big data, artificial intelligence (BDAl) and internet-enabled technologies to generate value.

The rapid development of information and communication technologies has accelerated the digitalization of organizations, fundamentally transforming how firms create and deliver value. Business models are increasingly being redesigned around digital technologies, particularly within young and entrepreneurial firms. As a result, traditional business models based primarily on physical assets and face-to-face interactions are progressively being replaced or complemented by digitally enabled business models. Digitalization therefore extends beyond technological adoption, reshaping organizational structures, customer relationships, value-creation processes and interactions among firms, customers and other stakeholders. Consequently, digital transformation has become a pervasive phenomenon affecting virtually every industry (Büyükoğkan and Göçer 2018).

Despite the increasing importance of digital technologies, technological innovation alone is insufficient to ensure successful business-model transformation. Human capabilities remain a critical strategic resource for designing, implementing and sustaining digital business models (Sivathanu and Pillai 2018). Likewise, research has consistently emphasized the central role of managerial and organizational capabilities in determining firm performance (Gunasekaran et al. 2017; Afshan and Motwani 2018). These developments create new challenges for organizations, particularly SMEs, which frequently operate under financial, technological and human resource constraints. Managers must therefore make strategic decisions regarding capability development, workforce reskilling and organizational adaptation. Questions such as how organizations should develop data scientists, how existing employees should be reskilled or how firms should respond to workforce displacement resulting from digitalization illustrate the growing complexity of managerial work during digital transformation.

From the perspective of the proposed framework, designing and implementing digital business models constitutes a distinctive category of digital managerial work. Unlike digital adoption tasks, which focus primarily on integrating digital technologies into existing organizational processes, digital business-model tasks require managers to redefine how the organization creates, delivers and captures value within increasingly digital markets. These responsibilities expose managers to new cognitive, strategic and organizational demands while simultaneously requiring them to leverage digital job resources and personal resources to sustain high levels of managerial work engagement.

Croll and Yoskovitz (2013) identify five core managerial tasks involved in developing digital business models: 1) creating acquisition channels; 2) defining selling tactics; 3) formulating revenue sources; 4) designing digital product types; and 5) determining delivery mechanisms. Within the present framework, these activities are conceptualized as digital business-model tasks because they require managers to continuously evaluate market opportunities, co-ordinate organizational resources, interpret digital information and make strategic decisions under conditions of considerable uncertainty. As these responsibilities become increasingly complex, managers' work engagement becomes essential for sustaining the cognitive effort, adaptability and strategic commitment required to successfully implement digital business models within SMEs.

Table 1. Linking Digital Business-Model Tasks With the New Job Demands and Resources Within SMEs

Digital managerial tasks in SMEs	Main questions	Tactics	Job demands	Job resources	Personal resources
Acquisition channel	How do the digital visitors, users or customers determine the firm?	Paid advertising; search engine management; artificial virality; app ecosystem	Sustained attention and timely reactions; maintenance and deployment	Big data, predictive analytics and artificial intelligence; automation	Technological reflectiveness; individual ambidexterity
Selling tactic	How does the firm convince visitors, users or customers to become paying customers?	Discounts; free trial; freemium	Sustained attention and timely reactions; maintenance and deployment	Big data, predictive analytics and artificial intelligence; automation	Technological reflectiveness; individual ambidexterity
Revenue model	How does the firm extract money from its visitors, users or customers?	Subscription; consumption charges; advertising clicks	Maintenance and deployment	Big data, predictive analytics and artificial intelligence	Individual ambidexterity
Product type	What does the firm offer in return for the revenue?	Software; platform; marketplace	Sustained attention and timely reactions	Automation	Technological reflectiveness
Delivery model	How does the product get to customers?	Digital delivery; hosted service	Sustained attention and timely reactions	Automation	Technological reflectiveness

Note: Adapted from Juyumaya and Torres (2023).

In the digital economy, new business models constitute the organizational context through which novel digital job demands and job resources emerge, thereby reshaping managerial work and influencing managers' work engagement and task performance.

Rather than simply incorporating new technologies, digital business models redefine how managers create, deliver and capture value, requiring them to perform increasingly complex cognitive, strategic and relational tasks. This transformation is particularly significant for SMEs, where managers frequently assume multiple strategic, operational and entrepreneurial responsibilities while operating under constrained financial, technological and human resources. From the perspective of the proposed framework, these emerging digital job demands and resources represent key elements of a human-centred approach to digital transformation in which managerial work engagement becomes a critical mechanism linking digital technologies to organizational performance.

For the digital managerial tasks summarized in Table 1, BDAI illustrates how digital technologies simultaneously reshape managerial work. For example, BDAI not only enables managers to acquire richer information about customers and markets — supporting activities such as acquisition channel development and selling tactics — but also substantially improves the quality, timeliness and accuracy of that information (Büyüközkan and Göçer 2018). In addition, digital technologies facilitate the development of innovative revenue models by allowing organizations to generate value from increasingly sophisticated data-driven business strategies.

Consequently, BDAI strengthens the connections between organizations and their customers while creating new managerial responsibilities related to interpreting digital information, monitoring customer behaviour and translating analytical insights into strategic decisions. For SME managers, these capabilities are particularly valuable because they help compensate for resource constraints by enabling more informed decisions and more efficient allocation of scarce organizational resources.

Customer integration remains a central determinant of organizational performance, particularly in relation to digital product design and delivery systems (Al Halbusi et al. 2022). However, effectively leveraging these digital capabilities requires managers to sustain high levels of work engagement. Successfully performing digital business-model tasks depends not only on access to technological resources but also on managers' capacity to invest cognitive, emotional and behavioural energy in their work. In particular, the dimensions of vigour, dedication and absorption become increasingly relevant in digitally intensive environments. From a cognitive perspective, vigour reflects the energy and mental resilience required to cope with complex digital demands, whereas absorption reflects managers' capacity to sustain visual attention and concentration while interacting with continuously evolving digital systems. These psychological resources enable managers to process large volumes of information, respond rapidly to changing digital environments and make effective strategic decisions under conditions of uncertainty — capabilities that are especially critical for SME managers, who often have fewer organizational resources and support structures than their counterparts in larger organizations.

Accordingly, the proposed framework highlights that managerial work engagement should be regarded as a strategic organizational capability rather than merely an individual psychological state. Organizations seeking to achieve successful digital transformation must therefore develop and sustain managerial engagement by ensuring that increasing digital job demands are matched with adequate job and personal resources. This consideration is particularly important for SMEs, where the success of digital transformation often depends directly on the capacity of a relatively small group of managers to lead organizational change, co-ordinate digital initiatives and mobilize limited resources effectively. When managers experience high levels of engagement, they are better positioned to integrate new digital technologies into organizational processes, design more effective digital business models and translate technological investments into organizational value creation. Consistent with previous research, managerial work engagement is positively associated with task performance through improved job fit (Venkatesh et al. 2003). Consequently, engaged managers are more likely to successfully adopt digital technologies, promote digital innovation and lead the continuous adaptation required for SMEs to remain competitive, resilient and sustainable in increasingly digital markets. Thus:

Proposition 1. Managers' work engagement is positively related to their task performance in digital adoption and digital business-model activities in small and medium-sized enterprises (SMEs).

CONSEQUENCES OF DIGITAL MANAGERIAL TASKS ON THE JD-R MODEL

Whereas meaningful job demands and resources can be found in almost every top management team, some job demands and resources are unique and related to the digital business context. For instance, physical demands, such as visiting customers across cities, are still essential for traditional real estate managers. In contrast, cognitive demands are much more relevant for chief scientist officers in fintech companies who are dealing with the problem of finding the optimal portfolio of real estate assets in a digital platform.

The JD-R model proposes two effects in which demands and resources may have a combined effect on managers' work engagement and indirectly increase their task performance

(Bakker and Demerouti 2017). First, job resources buffer the impact of job demands on the strain. Research has shown that job resources, such as social support, autonomy, performance feedback and development opportunities, can face managerial demands, including the manager's burnout (Xanthopoulou et al. 2009). Therefore, managers with many personal resources can cope better with their job demands. Second, job demands amplify the impact of job resources on work engagement (Bakker and Demerouti 2017).

Bakker and Albrecht (2018) suggest that job resources become salient and have the most decisive positive impact on work engagement when job demands are high. When a manager is confronted with challenging job demands, job and personal resources become valuable and foster vigour, dedication and absorption in the tasks. It includes the investment of cognitive, emotional and behavioural energies in work, dramatically impacting job satisfaction and performance (Kahn 1990; Rich et al. 2010).

Based on Bakker and Demerouti (2017), job demands and resources can evoke two separate processes in digital managerial tasks: 1) an energetic process of wearing out in which high job demands exhaust managers' cognitive resources and may therefore lead to burnout and eventually ill health; and 2) a motivational process in which job resources boost managers' work engagement. These characteristics do not differ from previous descriptions of employees' work; nevertheless, digital work also forces managers to reflect on adopting technology and how these technologies will positively impact task performance (Andrade-Valbuena and Torres 2018). The early focus of studies using the JD-R model centred primarily on front-line employees, non-managerial employees and first-line managers. With the framework, this paper emphasizes the analysis on the middle and top managers. Further, past research-study job attributes focused on inputs, repetitive tasks, traditional skills, clearly defined tasks, siloed metrics and slow and methodical work (e.g., Luoma 2000). The present conceptual study discusses the framework primarily focused on outputs, ad hoc activities, e-skills, unclear tasks, integrated functions, KPIs and fast, agile and efficient job attributes (e.g., Hofmann and Rüscher 2017).

Within SMEs, managers experiencing technological failures lead their teams in significant work challenges, such as achieving better standardization and continuously removing dysfunctional routines (Say and Vasudeva 2020). Firms pursuing an aggressive technology strategy in industries where technology is a critical contingency, such as high research-and-development spending, encourage managers to concentrate entirely on the success of new, innovative projects through a higher compensation scheme (Medcof and Lee 2017). Hence, engaged managers who are highly active, enthusiastic about and often fully immersed in their work should enhance organizational routines associated with digital managerial tasks.

NEW JOB DEMANDS: SUSTAINED ATTENTION AND TIMELY REACTIONS

Digital transformation has become mandatory for all firms and businesses. The new context is increased job demands as byproducts of technology introduction or an intrusion into private life facilitated by technology. For instance, evidence shows that the COVID-19 pandemic increased leader workload and work-family conflict. Technology can influence managers' well-being and make them more exhausted and less engaged. Digitalization can provide opportunities and constraints for managers' well-being and health and for their abilities to participate and thus co-shape the developments that affect them (Wilkinson et al. 2021).

Demerouti (2022) argues that digital technologies increasingly assume responsibility for the treatment, manipulation and processing of information, shifting managers' work away from routine operational activities toward cognitively demanding tasks that require the interpretation and integration of large volumes of data. Rather than reducing managerial work, digital transformation fundamentally changes its nature by increasing the cognitive complexity of decision-making. This transformation is particularly evident in SMEs, where managers frequently combine strategic, operational and entrepreneurial responsibilities while operating under constrained organizational resources.

Automation further contributes to this complexity by generating substantial fluctuations in managerial workload, ranging from periods of underload to episodes of rapid cognitive overload that require immediate responses (Parker and Grote 2022). Consequently, managers must continuously adapt to changing informational environments, rapidly prioritize competing demands and make timely decisions under conditions of uncertainty. As Bainbridge (1983) observed, even highly motivated individuals are unable to sustain adequate visual attention indefinitely when confronted with continuous streams of information. From the perspective of cognitive neuroscience, visual attention refers to the cognitive processes responsible for selecting relevant information while filtering irrelevant stimuli from increasingly complex visual environments. These cognitive limitations become particularly relevant as managers increasingly rely on dashboards, balanced scorecards, business intelligence systems and other digital decision-support technologies that require continuous monitoring and rapid interpretation.

Accordingly, traditional job demands based primarily on physical effort have progressively shifted toward demands centred on sustained attention, timely responsiveness and continuous cognitive monitoring. These emerging digital job demands require managers not only to process increasing quantities of information but also to maintain concentration over extended periods while responding effectively to continuously evolving digital environments. Within SMEs, these challenges are often intensified because managers frequently perform multiple organizational roles simultaneously, reducing the opportunities to distribute cognitive workload across specialized personnel.

The growing availability of digital information further amplifies these demands. Large volumes of data require managers to maintain sustained visual attention while responding rapidly to multiple organizational and environmental stimuli. Managers must continuously interpret complex digital information, evaluate algorithmic outputs and transform analytical insights into creative and innovative solutions for a wide range of organizational challenges. These responsibilities include interpreting algorithmic "black boxes," responding promptly to customers and business partners, monitoring organizational performance through digital platforms and managing increasingly dynamic relationships with stakeholders and shareholders across multiple digital communication channels.

From the perspective of the proposed JD-R framework, sustained attention and timely responsiveness therefore represent distinctive digital job demands that characterize contemporary managerial work. However, their effects on managerial work engagement are not inherently negative. Rather, they depend on the extent to which these increasing cognitive demands are balanced by adequate job resources, such as organizational support, usable digital technologies and managerial autonomy, and personal resources, including technological reflectiveness and individual ambidexterity. When this balance is achieved, managers are better able to sustain vigour, dedication and absorption despite the increasing cognitive complexity associated with digital transformation. Conversely, when digital job demands exceed available resources, managers may experience cognitive overload, exhaustion and declining work engagement, particularly within resource-constrained SMEs.

MAINTENANCE AND DEPLOYMENT

This paper argues that job demands change as managers take over maintenance and deployment tasks. Under certain conditions, firms can favour employment structures with less-skilled routine work but more highly technical professional work related to control, planning, maintenance and deployment. Combining big data and artificial intelligence with other technologies creates additional capabilities for digitally transformed firms. These capabilities can develop economies of scale and scope for the organization. Maintenance tasks are required to ensure optimal operating systems. Paradoxically, technology has supported and reduced specific tasks but has introduced new workloads associated with maintaining software, robots and platforms that provide management control and monitoring. Managers involved in digital managerial tasks increase the job demands of surveillance and performance monitoring (Parker and Grote 2022) associated with these digital environments. On the other hand, managers face deployment tasks (Parker and Grote 2022).

Deployment is where data mining yields results that impact task performance. The Cross-Industry Standard Process for Data Mining, known as CRISP-DM, is an open standard process framework that indicates approaches used by data-mining practitioners. According to CRISP-DM (Shearer 2000), managers use data information to improve the way to do business or generate new forms of income through a value proposition embedded in a digital business model. Managers must continuously acquire new knowledge to validate, sort and analyze big data to make strategic decisions (Meijerink et al. 2021). These new tasks require specific know-how and skills related to exploration and exploitation.

In digital managerial tasks, the purpose of human engagement with machines has a dual process, where managers or highly skilled employees enhance their decision-making process by augmenting their managerial capabilities. Individual ambidexterity can be an appropriate personal resource for managers to help complete deployment tasks (Torres et al. 2015). However, low-qualified employees are reduced to only those aspects where robotic machines still lack capabilities. For example, the gig worker is controlled by digital platforms and algorithms. Still, gig managers can make critical decisions across different countries with detailed information in real-time (Ravenelle 2019).

Managers increasingly experience greater autonomy and job complexity as organizations shift from valuing predominantly manual work toward mental work (Sennett 2008). Within digitally transforming SMEs, managers are expected not only to supervise organizational processes but also to interpret large volumes of information, co-ordinate digital technologies and make rapid strategic decisions under conditions of uncertainty. As a result, many managerial activities are increasingly mediated — or, in some cases, partially replaced — by mechanization, digital

platforms and algorithmic control. Although these technologies improve standardization and operational efficiency, they also restructure managerial work by increasing cognitive demands and requiring continuous monitoring of digital systems.

Many deployment and maintenance activities remain highly structured and standardized, as consistency and reliability are essential for the successful operation of digital infrastructures. However, these tasks frequently involve prolonged periods of visual attention, continuous monitoring, rapid responses to changing information and substantial cognitive effort. Consequently, deployment and maintenance activities should not be viewed solely as operational responsibilities but also as important sources of digital job demands that influence managers' work engagement, particularly within SMEs where managers often perform multiple strategic and operational roles simultaneously.

Importantly, the JD-R model suggests that the effects of job resources are inherently contingent upon their organizational context. As van Veldhoven et al. (2020) note, the value of a particular job resource depends on the level and nature of existing job demands as well as on the broader work environment. Building on this perspective, the present framework argues that the same digital technologies may function either as job resources or as job demands depending on the organizational conditions under which they are implemented. For example, technologies that enhance decision-making and reduce routine work may operate as valuable job resources when managers have sufficient autonomy, training, organizational support and system usability. Conversely, under conditions of limited support or high workload, these same technologies may increase cognitive overload, monitoring responsibilities and psychological strain.

Within digital managerial tasks, job demands and job resources are therefore characterized by the micro-tasks previously discussed, including sustained attention, timely responsiveness and deployment and maintenance activities. Rather than assuming that digitalization uniformly enhances managerial work, the proposed framework suggests that managers' work engagement depends on the balance between these increasing digital job demands and the availability of adequate job and personal resources. Consequently, digital job demands may either enhance or diminish managerial work engagement depending on how they are experienced and supported within the organizational context. This perspective provides a more nuanced understanding of digital managerial work and offers a richer explanation of how SMEs can design organizational practices and managerial support systems that sustain work engagement while mitigating the risks of cognitive overload and burnout. Consequently:

Proposition 2. Within SMEs, sustained attention, timely responsiveness and the maintenance and deployment of digital systems function as central job demands in managers' digital managerial tasks.

These demands are expected to reduce managerial work engagement when they are not matched by adequate job and personal resources; for instance, when managers face sustained attention and monitoring requirements without corresponding support, training or decision latitude. Conversely, when managers have access to sufficient job and personal resources, sustained attention, timely responsiveness and the maintenance and deployment of digital systems are expected to become compatible with, and potentially to enhance, managerial work engagement, consistent with the buffering and motivational mechanisms of the JD-R model (Bakker and Demerouti 2017).

NEW JOB RESOURCES

BIG DATA AND ARTIFICIAL INTELLIGENCE

The proposed framework groups big data and artificial intelligence (BDAI) with several job resources, such as big data, predictive analysis, machine learning and other computational algorithms. The traditional JD-R model considers resources in terms of physical capital, human capital, technological capital and tangible or intangible capital (Gunasekaran et al. 2016). This paper considers big data a job resource because this body of knowledge is responsible for analyzing and extracting data from large sets that are too complex to be dealt with by traditional data-processing tools (Chen and Zhang 2014). Big data resources include capturing, storing, analyzing, searching, sharing, transferring, visualization, querying and updating information privacy and data sources (McAfee and Brynjolfsson 2012). New interpretations of the JD-R model consider AI and automation because they enable a firm to deal with tasks that are difficult for humans due to the complexity of the operations and procedures (Gunasekaran et al. 2016).

Despite BDAI's numerous advancements, a large part of the literature considers them to be domains related only to a firm's processes and infrastructures (Chen and Zhang 2014), while a few articles have focused on the role of managerial cognition in facing new job demands based on BDAI (Caputo et al. 2019). An organization must develop BDAI acceptance and assimilation capabilities through BDAI routinization (Hazen et al. 2012). BDAI requires as much theoretical knowledge as it does a wide array of quantitative skills. The proposed framework supports the idea that BDAI is a job resource that can increase managers' work engagement because it involves a cognitive process of knowledge assimilation.

Managers are more likely to feel more engaged when their company's system and infrastructure have platforms and BDAI infrastructure because they need to address rapidly changing environments that integrate building and reconfigure internal and external data (Hazen et al. 2012). From a dynamic managerial capability perspective (Helfat and Peteraf 2015), an organization needs to develop BDAI acceptance and assimilation capabilities through the mediating construct of BDAI routinization. Routinization is the permanent adjustment of an organization's governance system to incorporate technology. Hazen et al. (2012) argue that routinization is the second stage of a threefold process: acceptance, routinization and assimilation. Organizations must accept, routinize and assimilate technologies to generate BDAI assimilation (Gunasekaran et al. 2016).

This paper argues that companies with BDAI resources could increase work engagement because managers perceive such resources to be relevant in dealing with new job demands. Caputo et al. (2019) state that it is necessary to accept, establish routines and assimilate new technologies to obtain benefits. In this regard, in the BDAI process, the first stage is acceptance, then routinization and finally, assimilation. BDAI resources also include technology and market surveillance processes, enabling managers to understand the current and latest trends in industries and markets. BDAI assimilation empowers a manager to think about the impact of a technological product on its users and society in general because BDAI environments stimulate this type of thinking (Gunasekaran et al. 2016).

AUTOMATION

Automation is a new technology by which a process or procedure is performed without direct human assistance (Parker and Grote 2022). For instance, managers can actively change the design of their jobs by choosing tasks, negotiating different job content and assigning meaning to their tasks or jobs. The availability of healthy-designed employment and working conditions facilitates manager motivation and reduces stress (Demerouti 2022).

Automation uses various equipment-operating control systems, such as machinery, processes in factories, boilers, heat-treating ovens, switching on telephone networks, steering and stabilizing ships, aircraft and other applications and vehicles with minimal or reduced human intervention. Following Demerouti's (2022) analysis, automation can contribute to work-related health if:

a) it is designed to support individuals' work; b) individuals are in control and can craft its use; c) job resources are maximized and job demands are affordable; d) economic growth is shared among stakeholders, including managers; and e) authorities protect managers and employees.

Job crafting represents a bottom-up adjustment of the tasks and characteristics of the job to fit one's preferences and find meaning in the position. According to the JD-R model, managers can craft their job by expanding (i.e., seeking resources and challenges) or reducing their scope (i.e., diminishing or optimizing demands) (Demerouti 2022).

Automation and job crafting may be an excellent combination of resources to increase managers' work engagement in digital managerial tasks. Accordingly, automation reduces cognitive and physical goals because it supports a manager's digital managerial tasks. To turn BDAI and automation into job resources, there is a need to analyze the nature and amount of the job resource (van Veldhoven et al. 2020), as well as the way the managers value the job resource regarding the task goal under consideration. Then:

Proposition 3. Within SMEs, big data, artificial intelligence and automation function as central job resources in managers' digital managerial tasks.

This resource function is conditional rather than automatic. Big data, artificial intelligence and automation are expected to operate as job resources, and thus to support managerial work engagement, when managers have sufficient autonomy over how these tools are used, adequate training to interpret their outputs, usable system design and organizational support for their adoption. Where these conditions are absent, the same technologies may instead operate as additional job demands, increasing cognitive load, decision pressure and monitoring burdens rather than easing them.

NEW PERSONAL RESOURCES

TECHNOLOGICAL REFLECTIVENESS

This paper recognizes a unique personal resource called technological reflectiveness, an individual's tendency to think about the impact of a technical product on different stakeholders, such as employees, customers and shareholders (Schweitzer et al. 2015). Technological reflectiveness draws on theories of reflection and reflexivity (Trapnell and Campbell 1999). The managers' work-engagement framework proposes that technological reflectiveness is a personal resource that can increase work engagement in the digital workplace characterized by digital managerial tasks. In fact, managers are more likely to feel more engaged when they have the individual tendency of technological reflectiveness (Andrade-Valbuena and Torres 2018).

The literature about technological reflectiveness aims to understand which individuals are effective contributors to technical innovations because they take society into account. In light of companies' R&D areas increasing endeavours to open up the innovation process and seize the abilities and skills of external sources in the innovation process (Gassmann 2006), the measure of technological reflectiveness can be used to recruit externals with high technology-reflectiveness scores to contribute to the innovation process. Despite the significance of technological reflectiveness, no previous studies link this resource to work engagement. Technological reflectiveness can supplement other job and personal resources, such as autonomy, supervisory encouragement, team support and managerial self-efficacy (Tierney and Farmer 2002), to achieve managers' work engagement.

A creative work environment may enhance a manager's feeling of control and resiliency, motivating them intrinsically (Amabile 1997), a prerequisite for work engagement (Xanthopoulou et al. 2013). Managers in digital tasks must reflect deeply on how new technologies impact technical solutions in the firm, market and society (Heavin and Power 2018). Technological reflectiveness is significantly related to the individual's willingness to promote new technologies (Andrade-Valbuena and Torres 2018). Hence, technological reflectiveness can be a crucial resource in achieving managers' work engagement because thinking about the impact of a technical product on its users and society can be critical in digital environments (Venkatesh et al. 2003).

INDIVIDUAL AMBIDEXTERITY

According to Mom et al. (2009), individual ambidexterity is a managerial orientation toward combining exploration- and exploitation-related activities within a particular timeframe. In the last decade, individual ambidexterity has become more concentrated on how leaders act ambidextrously to increase individual or group performance (Tushman and O'Reilly 1996).

The digital JD-R approach offers some arguments to support the idea that individual ambidexterity can be a personal resource that can boost managers' work engagement (McCauley et al. 1994). Managers prepare strategic plans that involve short- and long-term investments (e.g., capital expenditures). The board of directors must approve such initiatives annually. Strategy formulation requires significant resource mobilization, co-ordination and integration to maintain exploitation and exploration activities (Gibson and Birkinshaw 2004).

Managers are involved in several tasks, such as information sharing and knowledge processing, that require balancing short- and long-term tensions (Rosenkopf and Nerkar 2001). Moreover, managers can access the most valuable and diverse information to avoid separating explorative and exploitative behaviours (Sidhu, Volberda and Commandeur 2004).

Ambidextrous managers engage in complex cognitive processes, such as integrative and paradoxical thinking, to reconcile the tensions that emerge when pursuing multiple opportunities, goals and organizational needs that often differ in terms of time horizon, risk profile, strategic orientation and managerial responsibilities (Audia et al. 2000). Rather than perceiving these competing demands as mutually exclusive, ambidextrous managers are capable of integrating conflicting priorities into coherent strategic responses. This capability becomes particularly important in digitally transforming SMEs, where managers frequently face simultaneous pressures to maintain current operations while exploring new digital opportunities under conditions of limited financial, technological and human resources.

A defining characteristic of ambidextrous managers is their ability to balance exploration and exploitation without overemphasizing one at the expense of the other (March 1991). Instead of reinforcing the polarity between seemingly incompatible goals, they actively seek creative

solutions that integrate diverse organizational objectives by recognizing their interdependence. Within digital transformation processes, this capability enables managers to simultaneously pursue operational efficiency, digital innovation, customer responsiveness and organizational adaptability, despite the inherent tensions associated with these competing priorities.

Another important characteristic of managerial ambidexterity is the capacity to perform a broad repertoire of diverse and sometimes opposing managerial roles. Ambidextrous managers effectively combine routine and non-routine activities, operational and strategic responsibilities, leadership functions, entrepreneurial initiatives and creative problem-solving (Adler, Goldoftas and Levine 1999). They are also capable of rapidly shifting their attention between these different activities according to changing organizational circumstances and strategic priorities (Barnett 2008). This cognitive flexibility is particularly valuable in SMEs, where managers frequently perform multiple organizational roles simultaneously and where the successful implementation of digital transformation often depends on their ability to co-ordinate diverse responsibilities with limited organizational resources.

Accordingly, the present framework conceptualizes individual ambidexterity as a critical personal resource that enables managers to effectively cope with the increasing cognitive complexity associated with digital managerial work. By facilitating adaptive decision-making, cognitive flexibility and strategic integration, individual ambidexterity helps managers balance emerging digital job demands with available job resources while sustaining high levels of work engagement. In this sense, ambidextrous managers have frequently been described as multitaskers and generalists rather than specialists (Mom, Fourné and Jansen 2015), reflecting their capacity to integrate multiple perspectives and navigate the uncertainty, complexity and competing demands that characterize digital transformation within SMEs.

Previous studies indicate that ambidextrous managers have the skills and motivation to engage in learning activities, such as reliability enhancement, and increase learning activities to refine and refresh their knowledge and skills (Torres et al. 2015). They build internal linkages to co-operate, combine efforts with others and develop and maintain rather large, dense personal networks to share knowledge and information (van Wijk, Jansen and Lyles 2008).

Individual ambidexterity can be a critical personal resource for managers that fosters explorative and exploitative behaviour in them by increasing or reducing the flexibility of desirable behaviour (Mom et al. 2009). Considering the nature of digital managerial tasks, these individual tendencies of technological reflectiveness and ambidexterity can be essential personal resources for managers' task performance. Therefore:

Proposition 4. Within SMEs, technological reflectiveness and individual ambidexterity function as central personal resources in managers' digital managerial tasks.

These personal resources are expected to translate into stronger work engagement primarily when the organizational context allows managers to exercise them; for example, when firms tolerate experimentation and allow time for reflection on technology use. Where technological reflectiveness and individual ambidexterity are not activated by such organizational conditions, their contribution to managerial work engagement is expected to be more limited.

BOUNDARY CONDITIONS AND POTENTIAL NEGATIVE EFFECTS OF DIGITAL RESOURCES

The propositions above emphasize how digital job demands, job resources and personal resources can support managerial work engagement, but this relationship is not uniformly positive. Big data, artificial intelligence and automation, in particular, may also generate costs for managers that partially offset their benefits as job resources.

These tools can intensify performance surveillance and monitoring, increase the pressure to make rapid, data-driven decisions and introduce algorithmic opacity when managers cannot fully understand or explain the outputs of automated systems. Reliance on digital platforms and data infrastructure also creates new cybersecurity responsibilities that fall disproportionately on managers in SMEs, which typically lack dedicated information-technology staff. Because larger SMEs are generally better resourced to manage these risks than micro- and small enterprises, the same technologies that support work engagement in more capable firms may widen the capability gap between larger and smaller SMEs rather than closing it.

Read together with the boundary conditions specified in propositions 2 through 4, this discussion suggests that digital transformation does not automatically translate into higher managerial work engagement in SMEs. Its effects depend on whether managers are given the autonomy, training and organizational support needed to convert digital demands and resources into productive engagement, rather than into overload, surveillance or disengagement.

DISCUSSION

POLICY IMPLICATIONS

Building upon the proposed conceptual framework, this section develops a policy agenda for advancing digital transformation within SMEs from a managerial and human-centred perspective. While existing digital transformation policies have traditionally emphasized technological infrastructure, digital adoption and financial support for technology acquisition, the present study suggests that managerial work engagement represents an equally important — but comparatively underdeveloped — policy lever for improving digital transformation outcomes.

The proposed framework indicates that digital transformation should not be viewed exclusively as a technological or infrastructural challenge, but also as a managerial, cognitive and organizational one. Managers increasingly operate within environments characterized by continuous data flows, rapid decision cycles, algorithm-supported decision-making and permanent monitoring of digital systems. These conditions create new digital job demands, including sustained attention, timely responsiveness and continuous system management, which may either facilitate or undermine managerial performance depending on the resources available to support them. Consequently, digital transformation policies should explicitly recognize that investments in technology alone are unlikely to generate sustained benefits unless accompanied by investments in managerial capabilities and work engagement.

Accordingly, governments and SME support agencies should prioritize policies that strengthen managerial digital leadership capabilities. Beyond conventional digital skills training, managerial development programs should promote data literacy, strategic decision-making in digitally intensive environments, systems thinking and behavioural adaptability. Executive education initiatives should also incorporate topics related to cognitive workload management, digital well-being and managerial resilience, thereby helping managers cope with increasingly complex digital environments while sustaining high levels of vigour, dedication and absorption.

The framework also highlights the importance of ensuring equitable access to critical digital job resources. Because many SMEs lack the financial capacity to independently acquire advanced digital technologies, policymakers should complement existing digitalization initiatives with targeted policy instruments such as managerial digital capability vouchers, subsidized AI-as-a-service programs, shared cloud-based digital infrastructures, digital innovation hubs and public-private digital advisory services. These initiatives can reduce barriers to technology adoption while simultaneously strengthening managers' capacity to effectively use digital tools in organizational decision-making.

Importantly, the proposed framework suggests that digital technologies do not function as universal job resources. Their effectiveness depends on organizational conditions including managerial autonomy, adequate training, system usability and organizational support.

Consequently, policy interventions should move beyond promoting technology adoption and toward improving the organizational conditions under which digital technologies are implemented. This includes encouraging organizational practices that support effective job design, appropriate workload distribution, managerial autonomy, occupational well-being, flexible work arrangements and job-crafting initiatives capable of maintaining high levels of managerial engagement while reducing the risks of cognitive overload and burnout.

Because SMEs differ considerably in their resource availability and digital maturity, policy interventions should also be differentiated according to organizational characteristics. Micro-enterprises may benefit primarily from foundational digital capability programs, shared digital infrastructures and simplified advisory services, whereas medium-sized firms may require more specialized support for AI implementation, advanced analytics, organizational redesign and digital innovation management. Likewise, firms in the early stages of digital transformation require policies emphasizing capability building and technology access, whereas digitally mature SMEs may benefit more from initiatives supporting organizational learning, innovation ecosystems and advanced managerial development.

Given the diversity of APEC economies, successful digital transformation also requires collaborative institutional ecosystems. National SME development agencies, ministries responsible for digital transformation, innovation agencies, universities, technology providers and APEC working groups all have complementary roles in supporting managerial capability development. Policies that strengthen collaboration among these actors — including digital knowledge-sharing platforms, regional digital hubs, executive mentoring programs and cross-economy learning networks — can substantially improve SMEs' ability to acquire, interpret and apply new digital knowledge. Such initiatives also reinforce the development of critical personal resources, including technological reflectiveness and individual ambidexterity, that enable managers to successfully navigate continuous technological change.

Finally, integrating managerial work engagement into SME digital transformation policies has broader implications for inclusive, resilient and sustainable economic development across APEC economies. Engaged managers are more likely to promote innovation, improve organizational adaptability, strengthen resilience and successfully sustain digital transformation. By aligning investments in digital technologies with investments in managerial capabilities, cognitive resources and organizational support systems, policymakers can help ensure that SMEs are not only digitally equipped, but also managerially prepared to compete and thrive within an increasingly complex digital economy.

SMEs across APEC economies continue to face constrained access to financing, digital infrastructure and managerial capacity relative to larger firms (OECD 2023), and the intensity of the resulting digital gap increases with the sophistication of the technology involved (OECD 2021). Moving from general principles toward actionable guidance, APEC economies could consider a set of concrete policy instruments targeted at SME managers. These include SME digital leadership grants that fund targeted training for owner-managers and senior staff; subsidized access to AI-as-a-service and shared cloud infrastructure, which lowers the fixed cost of adopting sophisticated digital tools; managerial digital capability vouchers that SMEs can redeem for external advisory or training services; diagnostic tools that allow firms to assess managers' digital workload and burnout risk before it affects performance; public-private digital advisory platforms that connect SMEs with mentors and technology providers; and APEC-wide knowledge-sharing mechanisms that allow SMEs in different economies to learn from comparable firms' digital transformation experiences.

These instruments are unlikely to be equally relevant across the SME population. Micro-enterprises, which typically operate with a single manager and minimal administrative support, are likely to benefit most from low-cost, easy-to-access tools such as digital capability vouchers and shared infrastructure, whereas medium-sized firms with more established management teams may be better positioned to absorb structured leadership grants and advisory partnerships. Similarly, firms with low digital readiness may require diagnostic and foundational training support before they can meaningfully use big data, AI or automation tools, while digitally mature firms may benefit more from advanced advisory platforms and cross-economy knowledge exchange. Differentiating policy design along these dimensions, firm size, digital maturity and sector, should improve the efficiency and reach of digital economy programs targeted at SMEs across APEC economies.

Implementing these instruments requires co-ordination among several types of institutions. National SME development agencies are well positioned to administer capability vouchers and leadership grants; ministries responsible for the digital economy can lead the design of shared digital infrastructure and AI-as-a-service schemes; innovation agencies and universities can support advisory platforms and applied training; and relevant APEC working groups can facilitate cross-economy knowledge-sharing mechanisms and harmonize digital readiness diagnostics across member economies.

DIRECTIONS FOR FUTURE RESEARCH

The conceptual framework invites several research directions. A cognitive perspective can help identify heuristics and biases managers use when facing new digital job demands (Tversky and Kahneman 1974). Future studies may also integrate personal demands into the JD-R model (Bakker and Demerouti 2017) and explore how cognitive limitations, such as misperception, affect responses to job and personal demands.

Given the rising importance of visual attention in digital tasks, research should examine perceptual strategies and their relationship with engagement and performance. Neuroscience tools such as eye-tracking can support multidimensional analyses of how managers engage with digital systems. Empirical work is also needed to validate the research propositions, develop measures of new digital job demands and resources and refine conceptual definitions through qualitative insights. A concrete empirical agenda could operationalize the four propositions with survey-based measures of digital job demands (sustained attention, timely responsiveness, and the maintenance and deployment of digital systems); digital job resources (big data, AI and automation availability and usability); personal resources (technological reflectiveness and individual ambidexterity); and managerial work engagement and digital task performance,

drawing on established engagement and JD-R scales adapted to the digital managerial context. Such studies could be conducted with samples of SME owner-managers across specific APEC sectors with differing digital intensity, such as retail, manufacturing and business services, allowing comparison of how the proposed relationships vary with sector and firm size.

Mixed-methods designs combining these surveys with eye-tracking studies of managers' visual attention during digital tasks, and with qualitative interviews to refine construct definitions, would allow the propositions advanced here to be tested and, where necessary, revised.

CONCLUSIONS

Digital transformation poses significant challenges for SMEs by introducing new technologies, reshaping work processes and fundamentally redefining managerial responsibilities (Hsieh and Vergne 2022; Annarelli et al. 2021). By extending the JD-R model to the context of digital managerial tasks within SMEs, this paper advances a human-centred perspective on how managers experience, interpret and respond to the demands and opportunities associated with digital transformation. More specifically, the proposed framework identifies a set of distinctive digital job demands, digital job resources and personal resources that together provide a richer understanding of the psychological and behavioural mechanisms through which managers engage with digital transformation initiatives. In doing so, the paper positions managerial work engagement as a central mechanism linking digital managerial work to digital adoption, business-model innovation and organizational resilience.

Beyond its theoretical contribution, the framework offers a policy-oriented perspective for understanding digital transformation across SMEs operating in APEC economies. The analysis suggests that successful digital transformation depends not only on investments in digital technologies but also on developing the managerial capabilities, organizational conditions and institutional support systems necessary to sustain high levels of managerial work engagement. By integrating insights from organizational behaviour, strategic management and digital transformation research, the framework contributes to ongoing policy discussions by emphasizing that human capability development should accompany technological investment if SMEs are to achieve inclusive, resilient and sustainable digital transformation.

Finally, this study is intentionally conceptual. The framework and four research propositions developed here are designed to provide a foundation for future empirical research rather than to offer empirical validation within the present manuscript. Accordingly, the propositions are formulated to be tested, refined and extended across different SME contexts, sectors and APEC economies using quantitative, qualitative and mixed methods approaches. In this sense, the present study's contribution lies not only in extending the JD-R literature to the context of SME digital transformation, but also in providing an SME- and APEC-focused conceptual framework that distinguishes itself from previous general models of managerial digital work engagement by explicitly incorporating the resource constraints, contextual conditions and policy challenges that characterize digital transformation within SMEs.

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