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Dynamic Capabilities and Industry 4.0 Adoption as Drivers of Sustainability in Malaysian ICT Service SMEs: A Conceptual Framework

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Abstract

Small and medium-sized enterprises (SMEs) represent the backbone of Malaysia's economic development; however, their sustained competitiveness is increasingly challenged by the disruptive forces of the Fourth Industrial Revolution (IR4.0). While prior studies have primarily examined IR4.0 adoption in manufacturing contexts, limited attention has been accorded to the service sector, particularly Information and Communication Technology (ICT) SMEs. Anchored in the Dynamic Capability View (DCV), this conceptual study proposes a theoretical framework comprising four internal capability dimensions which are technological capability, digital organizational culture, organizational readiness, and financial capability with organizational sustainability as the dependent variable, mediated by IR4.0 adoption. Theoretically, this study contributes to extending DCV by integrating IR4.0 adoption as a mediating mechanism that translates internal dynamic capabilities into sustainable organizational performance. Empirically, the framework provides a structured foundation for future quantitative investigation using methods such as Structural Equation Modeling (SEM-PLS) to validate the relationships among dynamic capabilities, IR4.0 adoption, and sustainability. From a policy and managerial standpoint, the study offers actionable insights for SME stakeholders, emphasizing the strategic importance of digital capability-building and readiness enhancement under Malaysia's national initiatives such as Industry4WRD and NIMP 2030. Collectively, this paper advances theoretical understanding and practical approaches for accelerating digital transformation and sustainability among ICT service SMEs in Malaysia.

Keywords: Dynamic Capability, Industrial Revolution 4.0 Adoption, SMEs service sector, Malaysia

1. Introduction

Industrial Revolution 4.0 (IR4.0), is a disruptive shift in the industry, brought about by new technologies, which influenced numerous industries, industry and economy in the 4IR National Policy in Malaysia. The technologies include Artificial Intelligence (AI), Internet of Things (IoT), Blockchain, Cloud Computing, Big

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Data Analytics, and Advanced Technology. In the meantime, in a dynamic contemporary enterprise, IR4.0 is a necessity of small and medium-sized companies (SMEs), in the sense that the production, use and management would provide changes in market structure and so on (Sabo et al., 2024). As an example, decision making is fast, advanced shop floor monitoring, and demand forecasting (Hernandez et al., 2020). Automation of daily activities and real-time data insights enable SMEs to better use their resources, which eventually results in cost-saving and more profits (Bandari, 2019). As such, SMEs should determine their level of preparedness to recognize their strengths and weaknesses to stay competitive. It is so because the IR4.0 readiness assessment tool is predicted to gauge the employee's preparedness to the challenges that IR4.0 will present (Demong et al., 2021), including high investments and expertise (Saleh et al., 2023). However, gaps in the research revealed that the readiness assessment can be applied to large companies (Brozzi et al., 2018), long assessment process (Zaidi et. al., 2021; Saleh et. al., 2022), bias (Mohd et. al., 2022; Leang et. al., 2023) and require external consultation (Choi et. al., 2018; Saleh et. al., 2022), like Industry4WRD Readiness Assessment (MITI, 2018) and IMPULS Industry 4.0 Readiness Online Self-Check for Businesses.

The idea of IR4.0 has become widely recognised and adopted worldwide when Schwab (2017) pointed to the potential of transformation. The main purpose of IR4.0 is to increase automation and integration of biological and cyber-physical systems. As an example, Malaysia is introducing the use of AI and robotics to clean the market floor, ferry chickens off the trucks to hawker stalls, and intelligently handle waste (MOSTI, 2023). Analytic data and cloud computing enable businesses to use and make decisions based on the data to achieve a higher level of customer satisfaction and product quality (Ali et. al., 2021). According to Sabo et al. (2024), the businesses using big data will benefit by gaining a deeper insight into market and customer needs. Consequently, small and medium-sized enterprises are not the only ones that present businesses with opportunities and challenges to embrace these technologies (Telukdarie et al., 2023). SMEs is a significant part of the world economy, yet it frequently struggles to implement the process of digital transformation and IR4.0 including insufficient financial assets, experience, and readiness to change (Ganapathy, 2018; Jayashree et. al., 2019; Halili et. al., 2022; Lim et. al., 2023; Singaram et. al., 2023). This is in contrast with the large companies that possess large budgets and information technology department, and SMEs are struggling to fill sources on the technology implementation (Vuong et. al., 2021; Balakrishnan et. al., 2021; Ali et. al., 2023). Ready models have been proven as the tool to assess the level of readiness dan organization development in accepting new technologies (Chen et al., 2023).

2. Problem Statement

SMEs in Malaysia face persistent sustainability challenges due to market volatility, financial limitations, and technology gaps (Shahzad et al., 2023). The ICT service SMEs are well placed to be the forefront in digitalizing as many of them do not have organizational readiness and the commitment to leadership required to incorporate IR4.0 solutions in their business models. This constrains their rivalry and diminishes survival in the long term.

The literature highlights the necessity of dynamic capabilities to facilitate organizational resilience but there is limited literature that combines the concept of dynamic capabilities and factor of IR4.0 adoption to promote sustainability, especially within the context of Malaysian service SME. The literature on the topic usually targeted manufacturing SMEs (Jayashree, 2021; Marques et al., 2022), overlooking the specific solution issues by ICT services, like the rapid software cycles, cybersecurity concerns, and problem-driven innovation requirements.

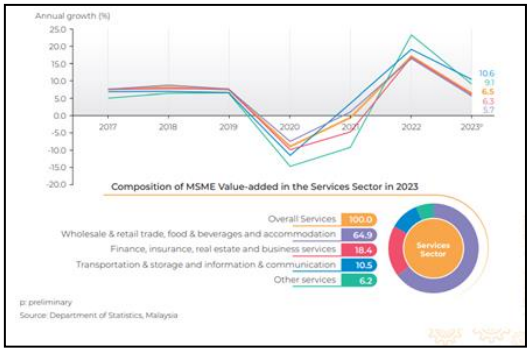

Fig. 1 Value-added Growth of MSME in the Services Sub-sectors (%)

According to SME Corp (2024), MSME Value-added in the Services Sector The positive trend in the services sector continued into 2023 with MSMEs remaining as the main contributor to the MSME GDP overall. Value-added of MSMEs in the sector reported an impressive growth of 6.5% (2022: 17.2%), and the growth was supported by the consumer-related sectors and the transport and storage sub-sectors (see Fig. 2). The sustained recovery of the tourism activities especially as the international boundaries of China reopened mostly helped these industries hence giving more momentum and supporting the overall development of the sector.

Furthermore, in surveying the sub-sector performance, the Wholesale and retail trade, food and beverages and accommodation sub-sector which contributed a major proportion of 64.9% of MSME value-added in the sector improved by 5.7 percent in the year. In the meantime, the transportation and storage and information and communication sub-sector showed even stronger growth, with a remarkable double-digit growth of 10.6% in 2023. The high performance of the given sub-sectors highlights the importance of service-related MSMEs to the overall economic recovery, especially given the growing need of logistics, digital infrastructure and consumer services in a post-pandemic setting.

The difference is further exaggerated in the perception of the mediation mechanism of IR4.0 adoption between the factors of dynamic capabilities and sustainability outcomes. In absence of this interconnection, SMEs will be at risk of undertaking a piecemeal adoption of technology that is not strategically aligned. Thus, the study is critical to explore the impact of technological capability, culture of innovation, organizational preparedness, and leadership ability in the IR4.0 implementation and sustainability of ICT service SMEs in Malaysia.

3. Purpose Research and Research Questions

The conceptual paper is intended to identify the links among dynamic capabilities and Industry 4.0 in sustaining ICT service industry SMEs in Malaysia. As such, research questions that will be addressed are:

i. Is there a relationship between dynamic capability factors and organizational sustainability in Malaysian ICT service SMEs?
ii. Is there a relationship between dynamic capability factors and IR4.0 adoption?

iii. Does IR 4.0 adoption mediate the relationship between the dynamic capability factors and organizational sustainability in Malaysian ICT service SMEs?

4. Significance of Research

The theoretical importance of this study is that the Dynamic Capability View is extended to the IR4.0 adoption background. Although it has been already confirmed that dynamic capabilities are the drivers of innovation and flexibility (Ahmad et al., 2021; Teece, 2018), not many studies have explored the direct correlation between dynamic capabilities and organizational sustainability in the context of ICT service SMEs. This study aids the development of theories in both strategic management and digital transformation research by placing the adoption of IR4.0 as an intermediary.

The practical importance is that it will inform owners and managers of SMEs in Malaysia on the need to put a priority on building their capabilities towards ensuring sustainability. These insights can be utilized by policymakers including SME Corp and MDEC to develop specific interventions, especially in leadership training, incentives on innovation, and digital preparedness initiatives (Saleh, 2024). The research is also part of the objective of establishing a competitive, resilient, digitally oriented SME sector in Malaysia as part of NIMP 2030.

This paper purposely targets the internal organizational drivers of IR4.0 adoption among Malaysian ICT SMEs: technological capability, digital organization culture, organizational readiness and financial capability. The dimensions are the resources and competencies that SMEs can directly build, manage, and reorganize to stay competitive. Although external influences, including government policies (e.g. Industry4WRD, NIMP 2030), regulatory frameworks and competition in the market are also admittedly significant in the larger adoption environment (MITI, 2023; SME Corp, 2023), they are not directly covered by this conceptual framework. The focus on internal drives allows the study to be consistent with the Dynamic Capability View (Teece, 2018), which focuses on how companies can pull on the strengths and renew the capabilities of the company to respond to technological disruption. However, the empirical expansion of this study in future may include external factors in the form of moderating variables or situational factors to give a more holistic and policy-constrained perspective of IR4.0 adoption in the SMEs.

Lastly, the paper is a conceptual contribution to the policy level in the sense that it identifies the gaps in capabilities that obstruct the ability of SMEs to align themselves with Industry4WRD. The increase in the dynamic capabilities of SMEs will not just increase the sustainability of firms but will also play a part in the digital economy agenda of Malaysia and competitiveness in the long term.

5. Theoretical Overview

This paper is based on the Dynamic Capability View (DCV) which highlights the capacity of the firm to identify opportunities and threats, exploit them by taking strategic actions and re-arranging resources to enable it stay competitive in the rapidly changing environments (Teece, 2007; 2018). DCV builds on the premise of the Resource-Based View (RBV) by focusing on one of its key limitations, that is, the assumption of a fixed set of resources. Although RBV considers the ownership of valuable, rare, inimitable, and non-substitutable (VRIN) resources to be sources of sustained competitive advantage (Barney, 2001), it does not elaborate how firms can rejuvenate, restructure, and redesign these resources to respond to technological upheavals like IR4.0. By comparison, DCV brings in an element of dynamicity and evolutionary viewpoint, understanding the mechanism through which organizations continuously adapt and re-align internal

capabilities with external transformations, a key element to ICT SMEs survival in turbulent digital ecosystems.

Comparatively, other more focused but less comprehensive explanations are provided by the Technology-Organization- Environment (TOE) (Tornatzky and Fleischer, 1990) and the Diffusion of Innovation (DOI) theory (Rogers, 2003). The TOE framework describes the factors that predict the adoption of technology based on the divisions of technological, organizational, and environmental contexts. But TOE does not provide a deeper explanation on how companies create internal capabilities to strategically utilize such contextual factors. In the same line, the DOI theory is interested in the way innovations are spread and accepted by organizations but leaves the question of the strategic adaptive and integrative capacity necessary to maintain innovation performance after such adoption.

In the case of ICT service SMEs, where usually there is a high rate of technology obsolescence, low financial ability, and strong pressure of innovation, DCV offers a more comprehensive and flexible theoretical perspective. It does not only measure the preparedness and capacity to embrace digital technologies but also the ways in which firms plan how to bring together technological capabilities, cultural capabilities, organizational capabilities, as well as financial capabilities to support performance. The DCV therefore fits the harsh reality of IR4.0 change in SMEs whereby the key determinants include adaptability, learning and the constant renewing of capabilities.

Moreover, DCV adds to the information received by RBV, TOE, and DOI because it combines their advantages, the internal resource view of RBV, the contextual sensitivity of TOE, and diffusion processes of innovation of DOI in one consistent system of transformation based on capabilities. Therefore, DCV is the most relevant theoretical framework in terms of the current study since it does not only discuss what resources SMEs have but also how they may use them dynamically and restructure them to achieve sustainability with the implementation of IR4.0.

6. Literature Review

The Industry 4.0 (IR4.0) adoption, dynamic capabilities, and sustainability literature in the context of SMEs has been changing significantly in the last ten years. Nevertheless, most of this literature is still biased towards the manufacturing industry, and little is achieved on the topic of service-based and ICT SMEs (Jayashree, 2021; Shahzad et al., 2023). Key themes and contradictions in the current research are critically reviewed in the next section, with conceptual tensions and unexplored research areas related to the study.

6.1. The Role of SMEs and ICT in the Malaysian Service Sector

Most business establishments in Malaysia (over 97% of the total) are Small and Medium Enterprises (SMEs), which play an important role in national GDP and jobs (SME Corp, 2023). Among this ecosystem, service-oriented SMEs have the highest proportion, and it includes sub-sectors like ICT services, professional services, e-commerce, which plays a key role in helping Malaysia transform into a knowledge-based economy (OECD, 2024). The developmental trend of the service sector is also strongly connected with the spread of ICT, where digital tools are becoming the foundation of business models, interaction, and accessibility to the market (DOSM, 2023).

The central enablers of the Malaysian digital transformation are ICT companies in the SME service sector. Such companies do not only use ICT within their organization to automate operations but also offer technology-related services including software creation, cloud computing, and cybersecurity to enable other SMEs to go digital. Such a dual role makes ICT SMEs adopters and providers of Industry 4.0 (IR4.0)

technologies, thus increasing their strategic value (Veeraya, Raman, Gopinathan, and Singh, 2024). To realise the industry4WRD and NIMP 2030 goals, SMEs in the ICT service industry should become technological adoption and digital resilience leaders in Malaysia.

Several issues surround ICT SMEs, such as financial constraints, shortage of talent and poor innovation ecosystems, despite their significance. The research emphasizes that organizational preparedness and cultural fit towards digitalization become a challenge among Malaysian service SMEs, which restricts the successful implementation of ICT (Her, Yap, Lee, and Rahman, 2020). All these barriers underscore the role of internal dynamic capability drivers like leadership support, technological capability, and innovation culture as pre-requisites to enable ICT SMEs to attain organizational sustainability.

This contradiction highlights a recurrent argument between structural preparedness (availability of digital infrastructure) and behavioural preparedness (cultural and leadership congruity). The former puts an emphasis on physical resources whereas the latter puts emphasis on adaptive thinking and dynamic processes. This paper puts dynamic capability as an integrative approach that aligns these two dimensions of readiness.

6.2. Organizational Sustainability in ICT Service Sector SMEs

Organizational sustainability has since shifted its traditional financial performance-based understanding to include environmental and social performance, which is typically referred to as the Triple Bottom Line (TBL) (Elkington, 1997; Marques, Ferreira, and Ferreira, 2022). In the case of SMEs, especially in the service industry, sustainability entails remaining competitive and at the same time addressing the expectations of the society and the environment. Considering Malaysia, ICT service SMEs are becoming pivotal drivers of sustainability since they are adopters and providers of digital solutions that facilitate long-term sustainability in the industries (Veeraya, Raman, Gopinathan, & Singh, 2024).

The digital transformation has been the focal point of the studies in recent years which highlighted the concept of sustainability. As an illustration, Jayashree et al. (2021) demonstrated that the stronger the alignment between dynamic capabilities, i.e., managerial commitment and IT infrastructure, with Industry 4.0 initiatives, the better TBL results with SMEs. This is congruent with Franco et al. (2024) who contend that the micro-foundations of sustainability in an unstable environment are the dynamic capabilities, especially the capacity to sense, seize, and in reconfigure, resources. In services concerning ICT, this is expressed in the form of being able to redesign the digital platforms and services offerings according to the needs of the clients without compromising operational efficiency and environmental responsibility.

Digital platforms are becoming more relevant in spurring sustainable service delivery in the Malaysian context. Mohamad et al. (2022) revealed that the digital co-creation platforms in Malaysia did not only support the internationalization of the SMEs but also conveyed practice that upheld organizational sustainability. This implies that ICT service SMEs are in a unique position to capitalise on digital solutions to sustainable growth. In addition, sustainability results are enhanced when companies develop robust information systems to monitor and report on sustainability indicators as noted by Zhao et al. (2021), which underlines the contribution of ICT companies to the development of information-driven sustainability solutions.

These contradictions point to the idea that digitalization itself is not enough to sustainability, but it should be complemented by internal dynamic capabilities that would make it possible to constantly adjust and learn. The above observation also supports the mediating effect of the IR4.0 adoption in the intended framework.

6.3. Industrial Revolution 4.0 (IR4.0) Adoption in Malaysian SMEs

The fourth industrial revolution (IR4.0) presents artificial intelligence (AI), Internet of Things (IoT), big data, and cloud computing as some of the technologies that can transform the business models in multiple

sectors. Nevertheless, uptake among the Malaysian SMEs is unequal. Using both the Diffusion of Innovation (DOI) and Technology-Organization-Environment (TOE) models, Shahzad et al. (2023) identified relative advantage, compatibility, competitive pressure, and top management support as the factors that strongly predict the adoption of IR4.0 in the Malaysian SMEs. Based on their findings, it can be argued that although the awareness of digital technologies rises, its successful implementation is strongly correlated with the organizational preparedness and the determination of the leadership to perform the latter.

The recent evaluation of the IR4.0 preparedness also highlights the weaknesses in the Malaysian SMEs. In a large-scaled survey of 506 SMEs, Techanamurthy, Iqbal, and Abdul Rahim (2025) identified weaknesses in five strategic dimensions which are leadership, governance, digital infrastructure, workforce competency, and strategic alignment. Such gaps can stop the complete integrations of SMEs within the national Industry4WRD framework and the New Industrial Master Plan (NIMP 2030). These results underscore the mismatch between the national policy ambitions and the ground-level capacity of SMEs, and their necessity to be addressed through specific interventions to improve preparedness.

In line with these observations, Saleh (2024) created an IR4.0 preparedness model that suits Malaysian SMEs and that recognizes organization, data, infrastructure, analytics, and IT development processes as the key dimensions of readiness. After analyzing 50 SMEs, the model indicated that the average level of readiness is only 66% implying that SMEs are in the right direction, yet the vast opportunities of capitalizing on IR4.0 technologies have not been realized. In the absence of systematic assistance in infrastructure and workforce reskilling, most of the SMEs will be at risk of shallow adoption that fails to translate into long-term competitiveness.

6.4. Industrial IR4.0 Adoption in ICT Service Sector SMEs

Industry 4.0 (IR4.0) technologies are frequently described by referring to technology-organization-environment (TOE) and Diffusion of Innovation (DOI) models, which emphasize that readiness, leadership, and environmental pressures are essential factors to consider (Tornatzky and Fleischer, 1990; Rogers, 2003). Shahzad et al. (2023) in Malaysia established that the IR4.0 adoption in the SMEs was greatly predicted by organizational readiness, compatibility, perceived relative advantage, and top management support. It means that the ICT service SMEs not only have to be technologically capable but also must be committed to the idea of leadership and organizational culture.

Nevertheless, there is a significant number of SMEs who are not ready to adopt IR4.0. Techanamurthy, Iqbal, and Abdul Rahim (2025) performed a nationwide assessment of 506 Malaysian SMEs and found significant deficiencies in leadership alignment, governance, digital infrastructure, workforce competency and strategic integration. These weaknesses are the reason why most SMEs, including ICT services, cannot move beyond the digital awareness to efficient adoption. The same results were observed by Wong et al. (2020) who have revealed that the adoption of blockchain by Malaysian SMEs was strictly dependent on the level of managerial support and trust, which are particularly applicable in ICT-service situations where companies must adopt the newest technologies at the organizational level and externally.

The soft factors that are important in the service industry include leadership and culture. Veeraya et al. (2024) demonstrated that the digital culture and digital leadership played a critical role in digital transformation in the digital business among Malaysian service SMEs. This is consistent with Zhang et al. (2022) who opined that the key to the success of digital transformation lies in leadership vision and employee empowerment. In addition, Torrent-Sellens et al. (2023) also demonstrated that the adoption of IR4.0 is the mediating variable between the environmental assets and companies' performance, which proves the idea that adoption is the mechanism that transforms capabilities into sustainability. In the case of ICT service SMEs, this brings out the fact that adoption does not just involve the acquisition of technology, but incorporation of the technology in the practices of the organization to realize long-term performance.

6.5. IR4.0 Adoption as Mediator

The concept of IR4.0 adoption is the degree to which companies are adopting digital technologies, including AI, IoT, cloud computing, and big data as part of their operations and service delivery (Vial, 2019). The adoption process is not hasty but relies on the internal capabilities including the leadership, readiness, and innovation culture. IR4.0 uptake in SMEs is usually not implemented in a holistic manner but more incrementally, as a response to resource and expertise limitations (Wong and Kee, 2022).

The mediating role of IR4.0 adoption is confirmed through empirical studies. Jayashree et al. (2021) revealed that the relationship between dynamic capabilities and sustainability outcomes among Malaysian SMEs is mediated by adoption. A similar correlation was also supported by Yavuz et al. (2023), who demonstrated that sustainable performance at SMEs is greatly promoted when the use of IR4.0 is incorporated into the routine operations. The adoption in ICT SMEs can be cloud-based service automation, AI-based personalization, or IoT-based monitoring that improve customer satisfaction and competitiveness directly.

In Malaysia, the adoption is low, and most SMEs use cost, lack of digital talent, and lack of ROI justification as reasons (Techanamurthy et al., 2025). Interventions like the Industry4WRD Intervention Fund by the government assist in providing financial aid, yet internal capabilities are needed to encourage its adoption. It is here that the significance of seeing adoption as the mediator between capabilities and sustainability outcomes lies.

6.6. Dynamic Capabilities in SMEs

Initially described by Teece, Pisano and Shuen (1997), dynamic capability theory (DCT) focuses on the capacity of a firm to include, create, and reorganize internal and external resources to respond to the emerging environments that change quickly. In the case of SMEs particularly in service industries, dynamic capabilities do not only prove to be beneficial but can also be viewed as a survival and sustainable growth factor in unstable markets. According to Ahmad, Ng, Kamal Basha, and Abdul Aziz (2021), dynamic capabilities in the SMEs directly lead to the improvement in the performance outcomes since it aids in the service innovation and improves the capability of adapting to institutional changes. The result highlights the need to create adaptive competencies in SMEs, especially in the developing economies like Malaysia.

The SME service industry, which is a major contributor of the GDP and employment of Malaysia, is experiencing challenges such as a scarcity of resources, unpredictable environmental trends and institutional demands. Such companies are usually not financially endowed and do not have access to talented labor and are susceptible to shocks. Dynamic capabilities thus become higher order processes that allow SMEs to effectively use the limited resources strategically. As Jayashree (2021) points out, the commitment of the top management and organizational culture, in combination with dynamic ability, are essential in allowing service innovation and service resilience under the disruption of the digital era.

In addition, the dynamic capabilities in SMEs are not limited to intra-organizational processes but include network and ecosystem integration. Increasing the involvement of Malaysian service SMEs in the globalized digital markets, their ability to detect market shifts, tap into technological opportunities and redesign operational models makes the difference between their survival and extinction. This three-tier operation not only makes them competitive but also places the SMEs in a position to reap long-term benefits of sustainability (Jayashree, 2021). Dynamic capability therefore is not just a hypothetical construct but a reality that SMEs in the Malaysian service environment need.

6.7. Dynamic Capabilities Enabling IR4.0 Adoption in ICT Service Sector SMEs

The Dynamic Capability View (DCV) is a solid conceptual framework to gain insights into the use and

utilization of IR4.0 technologies by SMEs. Teece (2018) conceptualized dynamic capabilities as the capacity of the firm to perceive opportunities, exploit them with the help of marshaling resources, and reorganizing the assets to remain competitive. The Jayashree et al. (2021) study in Malaysian SME realm verified that the commitment of the top management, the IT infrastructure, and organizational integration are paramount dynamic capabilities in the implementation of Industry 4.0 and the ensuing sustainability results. This gives a solid rationale to examine the factors of dynamic capability in ICT service companies.

ICT service SMEs are especially applicable in four dimensions of dynamic capability, which are technological capability, digital organization culture, organizational readiness and financial capability. According to Lepore et al. (2023), inbound open innovation in building technological capabilities facilitates the adoption of Industry 4.0, which is essential to ICT companies that often involve third-party digital platforms and cloud services. The culture of innovation is also an important factor, which Marques et al. (2022) established as SMEs with robust innovation cultures were more capable of adaptation to the technological change and maintain a competitive role. The culture of innovation in ICT services is associated with agile development practices, cooperative problem-solving, and the willingness to be innovated by the clients.

Another factor that is critical is financial capability. The digital transformation to I4.0 involves both physical and immaterial assets, including equipment, machinery, technological recommendations and expertise. As the digital transformation process presupposes the use of new technologies, the companies would need to seek new equipment, the suppliers of other appropriate related services. Therefore, financial capital also plays a major role in helping the firms initiate their I4.0 journey. This research defines financial capability as: financial capacity of a firm to invest in the operational assets including technology, machinery and skilled labor needed to enhance business performance. Based on the RBV statements, we view it as a suitable theory to discuss the performance of SMEs, as it explains adequately how firms and entrepreneurs manage their businesses through acquisition of valuable and strategic resources and capabilities.

Accordingly, theoretical basis of the study is pegged on the RBV of the firm. Moreover, RBV is geared towards the utilization of the said resources and capabilities in the generation of competitive advantages, which makes it strong provided that these resources are hard-to-copy (Barney et al., 2001; Dierickx and Cool, 1989). In line with Caldeira and Ward (2003), RBV views firms as possible sources of value-added capabilities at the business level, competences at the organizational and individual level and skills. Although Arifin and Frmanzah (2015) used the RBV perspective to suggest dynamic capabilities related to the adoption of technology, Oliver (1997) and Zheng et al. (2013) mentioned that resources, in addition to the institutional capital, are required to build competitive advantages. Then, we assume that financial capability is an essential consideration in the preparation of I4.0. Bettiol et al. (2021) argue that top-performer SMEs in Italy have been encouraged to acquire robots and powerful data analytics systems due to the financial resources. Besides, Kazemargi and Spagnoletti (2020) mentioned the significance of investing in IT to make SMEs able to adopt I4.0. Taken together, these results demonstrate that dynamic capabilities do not only enable the adoption of IR4.0 but also the degree of how the adoption leads to sustainability outcomes in ICT service SMEs.

This deviation shows that there are no unifying structures that integrate these internal factors. Therefore, this paper suggests a holistic framework that consists of technological capability, digital organizational culture, organizational readiness, and financial capability as the four main dynamic capabilities that mediate the sustainability with IR4.0.

6.8. Summary and Conceptual Gap

Critical synthesis of the available literature has shown several conflicting issues and tensions in theories:

Table 1. Thematic synthesis of contradictions and implications in the existing literature

Theme	Dominant View	Contradictory View / Gap	Implication for This Study
Digital Adoption and Sustainability	Efficiency and competitiveness are enhanced through adoption (Jayashree et al., 2021; Franco et al., 2024).	Integration is also required to ensure high cost and stability with over-adoption (Zhao et al., 2021).	Explore adoption of IR4.0 as a mediator and not a final goal.
Capability Drivers	Digital success is achieved with enough technological capabilities (Dubey et al., 2020).	Soft capabilities (leadership, culture) are also as important or more so (Veeraya et al., 2024).	Incorporate hard (technology) and soft (culture, readiness) dimensions in the framework.
Adoption Models (TOE/DOI vs. DCV)	TOE/DOI clarify situational preparedness (Rogers, 2003).	These models ignore the fact of internal capability evolution (Teece, 2018).	Use DCV to attract the dynamic adaptation and recapability refresh in the SMEs.
Empirical Evidence in Service SMEs	The body of research mostly revolves around manufacturing (Shahzad et al., 2023).	The unexplored areas are service SMEs, particularly ICT (Ahmad et al., 2021).	This empirical gap in ICT service SME context with position research.

The literature is coherent in its view that although the adoption of IR4.0 increases the competitiveness, the long-term sustainability effect of the practice is conditional to the fact whether a firm will be able to develop and reorganize the dynamic capabilities. Most of the studies, however, deal with these factors separately and do not combine them into a single system. Furthermore, inconsistent results of the role of technology versus culture illustrate the necessity of including a mediating structure, namely, the introduction of IR4.0 that would connect internal powers with the maintenance of the results.

Therefore, this paper addresses these gaps by creating a theoretical framework based on the Dynamic Capability View by making the adoption of IR4.0 the mediating forces between the internal dynamic capabilities and the sustainability of the organization in the previously under researched setting of ICT service SMEs in Malaysia.

7. Conceptual Model Development

This research builds a conceptual model incorporating the dynamic capability theory (DCT) and the mediating influence of Industry 4.0 adoption to define organizational sustainability among Malaysian ICT service SME. The framework identifies four independent variables, such as technological capability, digital organization culture, organizational readiness, and financial capability, as the core dynamic capabilities that have a direct and indirect effect on sustainability via IR4.0 adoption.

Although external factors like government policies, regulatory frameworks, and market competition are a well-known key factor in digital transformation, they are deliberately avoided in the current conceptual framework to both be able to create theoretical coherence and to guarantee methodological accuracy. This exclusion is related to the Dynamic Capability View (DCV) that is characterized by the fundamental intra-organizational processes that help firms feel, grab, and use resources in reaction to environmental turmoil (Teece, 2007; 2018). The inclusion of extraneous variables would run the risk of diffusing the theoretical focus of the DCV and dealying the framework closer to contextual model like Technology Organization Environment (TOE) paradigm (Tornatzky and Fleischer, 1990) which is more of an antecedent of the technological adoption and not the internal capability development. In this way, the theoretical purity of the model is retained and a more accurate analysis of the mechanisms by which firms create sustainable

performance by dynamic processes is possible.

Regarding the methodology, internal capabilities are also more measurable and cross-firm comparable than external or institutional variables, which usually change by industry dynamics, governmental incentives, or regional policies (Ahmad et al., 2021). Excluding these context-dependent elements enhances construct validity and minimizes potential bias arising from environmental heterogeneity. This methodological precision not only strengthens the clarity of the conceptual model but also ensures that future empirical research can accurately measure and explain how internal capabilities influence IR4.0 adoption and organizational sustainability without distortion from uncontrollable contextual noise.

Furthermore, this focus sharpens the analytical relevance of the model by emphasizing the internal elements that firms can directly influence, namely technological capability, digital organizational culture, organizational readiness, and financial capacity. Concentrating on endogenous factors not only aligns with DCV's theoretical assumptions but also enhances the framework's practical utility by guiding SME managers and policymakers toward actionable internal strategies. Nonetheless, it is acknowledged that external factors may interact with these internal capabilities. Hence, future empirical research should incorporate potential moderating variables such as environmental dynamism, regulatory support, or technological turbulence to test the robustness and generalizability of the model. Such extensions would enable a more holistic understanding of how internal and external forces jointly shape the sustainability of ICT service SMEs within the evolving Industry 4.0 landscape.

Based on the literature, this paper proposes the following model:

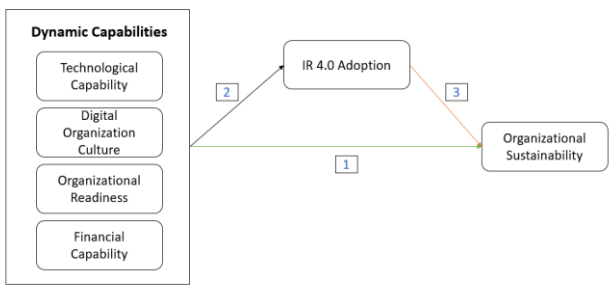

Fig. 2 Conceptual Framework; Source: adapted from Shahzad et al. (2023) and Ahmad et al. (2021)

According to the dynamic capability theory, internal resources need to be felt, captured and reshaped to stay competitive in unstable environments (Teece, 2007). Dynamic capabilities in ICT SMEs manifest in the technological capability, digital organization culture, organizational readiness, and financial capability. Nevertheless, these capabilities cannot work alone and need to be converted into action via IR4.0 adoption, which serves as a mediating mechanism (Jayashree et al., 2021; Yavuz et al., 2023). The hypotheses development from the framework as shown in table below.

Table 2. Hypotheses Development

Code	Hypothesis
H1	Dynamic Capabilities positively influence organizational sustainability in ICT service SMEs.
H2a	Technological capability positively influences IR4.0 adoption in ICT service SMEs.
H2b	Digital organization culture positively influences IR4.0 adoption in ICT service SMEs.

H2c	Organizational readiness positively influences IR4.0 adoption in ICT service SMEs.
H2d	Financial capability positively influences IR4.0 adoption in ICT service SMEs.
H3	IR4.0 adoption positively influences organizational sustainability in ICT service SMEs.
H4	IR4.0 adoption mediates the relationship between dynamic capabilities (technological capability, digital organization culture, organizational readiness, and financial capability) and organizational sustainability in ICT service SMEs.

8. Conclusion

This concept paper develops an argument which holds that the factors of dynamic capabilities are critical drivers of organizational sustainability in Malaysian ICT service SMEs. Combining DCV and IR4.0 adoption into a framework, the proposed framework outlines the significance of technological capability, digital organization culture, organizational readiness, and financial capability as facilitators of sustainable results. The mediation of the IR4.0 adoption guarantees that the dynamic capabilities are transformed into the concrete gains of resilience, innovation, and competitiveness.

The proposed conceptual paper further advances the academic debate on dynamic capabilities and the digital transformation by presenting a model explaining the internal processes by which Malaysian ICT service SMEs attain organizational sustainability through the paradigm of Industry 4.0. The framework, based on the Dynamic Capability View (DCV), hypothesises that the four central internal dimensions technological capability, digital organizational culture, organizational readiness, and financial capability form the bases on which companies build the ability to adjust, innovate, and achieve success in digitally unstable environments.

Theoretical Contributions

The research makes contributions to theory in several ways. First, it generalizes the DCV to the area of IR4.0 adoption, which provides a dynamic description of how internal capabilities are converted into long-term performance results. The DCV also offers a better analytical prism than the Resource-Based View (RBV), which considers resource endowments as fixed, or contextual models like TOE and DOI, which consider the processes of capability renewal in SMEs to be adaptive and evolutionary. Second, the paper presents an insightful conceptualization of IR4.0 adoption as a mediating mechanism by providing a finer insight into the channel through which internal capabilities are transformed into sustainability benefits. This mediation view augments available literature that has tended to view adoption as a predictive variable, as opposed to an alternative process.

Practical and Policy Implications

Regarding the managerial perspective, the model offers a practical diagnostic framework that allows SME leaders to evaluate and improve their in-house strengths to be ready to undergo digital transformation. It points out that the successful implementation of IR4.0 incorporates more than merely investing in technology but also includes cultural adjustment, organizational readiness, and financial flexibility. To the policymakers, the framework supports the formulation of targeted interventions by the agencies like SME Corp, MDEC, and MITI, where the shift is made to the policy initiatives that may focus on infrastructural support to policy initiatives that develop dynamic and learning-oriented capabilities among the SMEs.

Overall Significance and Future Directions

The suggested model is one of the rare ones that connect the theoretical and practical aspects of digital transformation. It contributes to the academic knowledge by placing dynamic capabilities on the center of sustainable performance and offers a practical guide to ICT service SMEs on their way towards a more robust, innovation-based digital economy in Malaysia. Quantitative empirical testing of this model can occur in future studies through structural equation modelling or multi group analysis to determine the soundness of this model and moderate effects in the form of turbulence of the environmental setting or government subsidising.

Overall, this paper provides a framework that is both theoretically sound and practically applicable and outlines how and why dynamic capabilities, which are facilitated by the adoption of IR4.0, lead to the creation of a sustainable organizational outcome. It thus adds to the current discussion on SME competitiveness and sustainability in the digital age.

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