

From Intellectual Capital to Sustainable E-Commerce Ecosystems: The Roles of Digital Capability and Digital Risk Management in Smes

Antony Santhosh K.X.

Research Scholar, School of Management Studies, Cochin University of Science and Technology, Ernakulam

Abstract

The growing use of digital commerce has created new business opportunities for small and medium enterprises (SMEs), while exposing them to new technological and cybersecurity risks. To remain competitive and successful in digital marketplaces, SMEs must develop capabilities to use digital technologies while managing digital risks. Intellectual capital has been recognized as an important organizational resource that supports organizational innovation and capability development. However, few studies have explored how intellectual capital contributes to the development of digital capabilities and digital risk management in the context of sustainable e-commerce ecosystems. This study proposes a conceptual framework describing the relationships among intellectual capital, digital capability, digital risk management, and sustainable e-commerce ecosystems in SMEs. Based on the intellectual capital perspective and the knowledge-based view of the firm, the study proposes that intellectual capital serves as a foundational knowledge resource that enhances both digital capability and digital risk management. Digital capability also strengthens firms' ability to manage technological risks and supports the long-term sustainability of e-commerce operations. The paper presents several propositions describing these relationships and discusses their implications for SME competitiveness in digital markets. The proposed framework adds to the literature by integrating intellectual capital, digital capability, and digital risk management within an integrated perspective of sustainable digital commerce.

Keywords: Digital Capability, Intellectual Capital, SME, Sustainable E-commerce

1. INTRODUCTION

The growing use of digital technologies has transformed the way businesses operate and interact with customers. Technologies such as e-commerce platforms, digital payment systems, cloud computing, and data analytics has enabled firms to expand their market reach and enhance operational efficiency. These technological developments have been particularly beneficial for small and medium enterprises (SMEs), which often face limitations in financial and physical resources. By using digital technologies, SMEs can improve customer engagement and compete more effectively in global markets (Bharadwaj et al., 2013). Along with these opportunities, digital transformation also introduces new challenges for organizations. As firms increasingly rely on digital platforms and online transactions, they become more exposed to

technological and cybersecurity risks. Examples include data breaches, cyberattacks, system disruptions, and technological vulnerabilities can significantly affect business continuity and stakeholder trust. These risks are especially important for SMEs, which may lack the technological expertise and resources needed to manage complex digital infrastructures (Nambisan, 2017). Therefore, firms must develop capabilities that allow them not only to adopt digital technologies but also to manage the risks associated with digital environments. In such situations, organizational knowledge resources play an important role in helping firms adapt to digital transformation. The concept of intellectual capital is used as a theoretical perspective for understanding how knowledge-based resources contribute to organizational performance. Intellectual capital refers to the collective knowledge assets embedded within organizations, including employees' expertise, organizational processes and systems, and relationships with external stakeholders (Edvinsson & Malone, 1997; Stewart, 1997). These intangible resources enable firms to develop capabilities and sustain competitive advantage in dynamic environments.

Prior studies show that intellectual capital influences several organizational outcomes, including, knowledge creation and strategic flexibility (Bontis, 1998; Subramaniam & Youndt, 2005). Firms with strong intellectual capital are better able to recognize opportunities and adapt to environmental changes. As digital transformation is adopted in many organizations, intellectual capital is viewed as a key resource that supports the development of digital capabilities. Digital capability refers to an organization's ability to adopt and use digital technologies to improve business processes. Firms with strong digital capabilities can use digital tools to enhance operational efficiency and improve customer experience (Warner & Wäger, 2019). For SMEs, digital capability is important because it enables them to overcome resource constraints and compete in digital markets. However, effective use of digital technologies also requires organizations to manage the risks associated with digital systems.

Digital risk management has become an important part of current business strategy. Digital risk management refers to the processes through which organizations identify and mitigate risks related to digital technologies, including cybersecurity threats and technological disruptions. Effective digital risk management helps organizations protect digital assets and maintain stakeholder trust in digital environments (Bhimani, 2014). In e-commerce settings, where transactions and data exchanges occur continuously through digital platforms, the ability to manage digital risks is important for sustaining long-term business operations. Reliance on digital technologies has led to the emergence of complex e-commerce ecosystems in which firms interact with customers, technology providers, and other stakeholders through interconnected digital networks. The sustainability of these ecosystems depends on firms' ability to maintain secure digital operations while adapting to market changes (Autio et al., 2018). For SMEs in digital markets, developing capabilities that support both digital innovation and risk management is essential for long-term competitiveness.

Although previous studies have examined intellectual capital, digital capability, and digital risk management independently, limited research has examined how these constructs interact to influence the sustainability of e-commerce ecosystems. Therefore, future research requires theoretical frameworks that explain how knowledge-based resources such as intellectual capital contribute to the development of digital capabilities and risk management mechanisms that support sustainable digital business systems. To examine this issue, this study proposes a conceptual framework linking intellectual capital, digital capability, digital risk management, and sustainable e-commerce ecosystems in SMEs. Based on the intellectual capital perspective and the knowledge-based view of the firm, the study suggests that intellectual capital serves as a foundational resource that enhances both digital capability and digital risk

management. These capabilities contribute to the sustainability and resilience of e-commerce ecosystems. By developing theoretical propositions, this study seeks to provide insights into how SMEs can utilize knowledge-based resources to strengthen their participation in digital markets.

Existing studies on intellectual capital primarily focus on its relationship with innovation, organizational performance, and competitive advantage, while research on digital capability often emphasizes technological adoption and digital transformation processes. Similarly, studies on digital risk management tend to concentrate on cybersecurity practices and technological safeguards in digital environments. Few studies examine these three domains together. Consequently, it remains unclear how intellectual capital as a knowledge-based resource supports the development of both digital capability and digital risk management in SMEs. Furthermore, the implications of these relationships for the sustainability of e-commerce ecosystems remain underexplored. As SMEs rely more heavily on digital platforms for business operations, understanding how intellectual capital supports the development of technological capabilities and risk management mechanisms becomes essential. This study addresses this gap by developing a comprehensive theoretical framework. This framework links intellectual capital, digital capability, digital risk management, and sustainable e-commerce ecosystems.

The remainder of the paper is organized as follows. The next section reviews the relevant literature on intellectual capital, digital capability, digital risk management, and sustainable e-commerce ecosystems. The paper then presents the theoretical propositions based on the proposed conceptual framework. The paper then discusses the theoretical and managerial implications of the framework. Thereafter future research directions and conclusion part is included.

2. Literature Review

2.1 Intellectual Capital and Organizational Capabilities

In knowledge-driven economies, intangible resources have become critical determinants of organizational competitiveness. Among these resources, intellectual capital has received considerable attention in management research. Intellectual capital broadly refers to the collective knowledge assets embedded within organizations that enable firms to create value and sustain competitive advantage (Edvinsson & Malone, 1997; Stewart, 1997). The intellectual capital perspective emphasizes that firms derive value not only from physical assets but also from knowledge-based resources that support learning and innovation. The knowledge-based view of the firm identifies knowledge as one of the strategically significant resources that organizations possess (Grant, 1996). Firms that effectively use intellectual capital are more capable of adapting to dynamic environments.

Previous studies show that intellectual capital contributes significantly to innovation capability and organizational performance (Bontis, 1998; Subramaniam & Youndt, 2005). By facilitating knowledge creation and sharing, intellectual capital enables firms to improve their ability to identify new opportunities and solve complex problems. For SMEs, intellectual capital is particularly important because these firms typically operate with limited financial and technological resources. Knowledge-based resources allow SMEs to overcome such limitations by supporting learning and capability development (Inkinen, 2015). SMEs that effectively leverage intellectual capital can easily adapt to technological change and participate in digital markets. As organizations adopt digital technologies, intellectual capital plays an important role to develop capabilities required for digital transformation. Knowledge resources within organizations help firms understand technological opportunities and develop innovative digital solutions. Intellectual capital acts as a key resource that supports the development of digital capabilities within organizations.

2.2 Intellectual Capital and Digital Capability

The growing use of digital technologies has led to increasing attention toward the concept of digital capability. Digital capability refers to organization's ability to adopt, integrate, and utilize digital technologies in ways that enhance business processes to create value (Warner & Wäger, 2019). Digital capabilities enable firms to use digital platforms and data analytics to improve efficiency and innovation. In digital business contexts, organizations must develop competencies that allow them to utilize digital tools effectively while adapting their organizational processes and technological changes (Bharadwaj et al., 2013).

For SMEs, digital capability is important because digital technologies can help overcome limitations related to size and resource availability. Through e-commerce platforms and digital marketing tools, SMEs can access broader markets and interact directly with customers to develop new business models (Nambisan, 2017). Developing digital capability requires knowledge resources. Firms must possess the expertise necessary to understand technological opportunities in order to update their competencies. Intellectual capital provides the knowledge base for developing digital capabilities. Organizations that possess strong knowledge resources are more capable of learning new technologies and using them into their operational processes. Empirical studies have emphasized the role of knowledge resources in supporting technological capability development (Bharadwaj et al., 2013; Warner & Wäger, 2019). Firms with stronger intellectual capital are generally more capable of implementing digital innovations and adapting to technological changes. Therefore, intellectual capital can positively affect the development of digital capabilities within SMEs.

Proposition 1: Intellectual capital positively influences digital capability in SMEs.

2.3 Intellectual Capital and Digital Risk Management

While digital technologies create new opportunities for firms, they also introduce different types of vulnerabilities. Organizations operating in digital environments face challenges related to cybersecurity threats, data privacy breaches, system failures, and technological disruptions. These risks can affect the reliability of digital business operations. To manage these risks, organizations must develop effective digital risk management practices. Digital risk management refers to the processes used by firms to identify, assess, and mitigate the risks associated with digital technologies and information systems (Bhimani, 2014). Effective digital risk management practices help organizations protect digital assets and ensure secure digital transactions.

The ability to manage digital risks depends on technological infrastructure as well as knowledge and expertise available within organizations. Firms must possess the necessary knowledge to understand technological vulnerabilities and implement appropriate security measures. Intellectual capital plays an important role in supporting these capabilities. Organizations that possess strong knowledge resources are more capable of interpreting complex technological information and implementing appropriate risk mitigation strategies. Previous studies indicate that knowledge-based resources support the development of organizational capabilities related to risk identification and problem solving (Grant, 1996; Inkinen, 2015). For SMEs engaged in e-commerce, intellectual capital can strengthen firm's ability to manage digital risks by enabling the development of knowledge-based security practices and risk management procedures. Thus, intellectual capital is likely to positively influence digital risk management capabilities.

Proposition 2: Intellectual capital positively influences digital risk management in SMEs.

2.4 Digital Capability and Digital Risk Management

Digital capability supports technological innovation and strengthens organizations' ability to manage

digital risks. Firms with stronger digital capabilities possess advanced technological infrastructures and expertise that allow them to monitor digital systems and detect system vulnerabilities. Organizations that have developed strong digital capabilities are better positioned to implement cybersecurity systems and data protection systems that reduce the digital threats. These capabilities enable firms to detect abnormal system activities and maintain secure digital operations.

Research on digital transformation suggests that organizations with strong digital competencies are more capable to manage technological uncertainties and operational risks (Warner & Wäger, 2019). Digital capability therefore improves the ability to identify and mitigate risks associated with digital technologies. In e-commerce environments, where firms rely heavily on digital platforms and online transactions, digital capability ensures secure operations. Firms with higher levels of digital capability are better able to develop effective digital risk management practices that support the stability of digital systems.

Proposition 3: Digital capability positively influences digital risk management in SMEs.

2.5 Digital Capability, Digital Risk Management, and Sustainable E-Commerce Ecosystems

The increasing reliance on digital technologies has resulted in complex e-commerce ecosystems, where firms interact with customers and partners through interconnected digital platforms. These ecosystems facilitate the exchange of information, goods, and services in digital environments (Autio et al., 2018). For SMEs operating in digital markets, the sustainability of e-commerce operations depends on their ability to maintain stable digital systems while continuously adapting to technological changes. Sustainable e-commerce ecosystems require organizations to build capabilities supporting both innovation and risk management.

Digital capability helps firm improve operational efficiency and improve customer engagement. Organizations with strong digital capabilities are better able to respond to changing market demands and technological developments. Digital risk management also helps ensure the stable and resilient digital systems. Effective risk management practices protect digital assets and maintain system reliability. Collectively, digital capability and digital risk management contribute to the sustainability of e-commerce ecosystems by enabling firms to operate securely and efficiently in online environments.

Proposition 4: Digital capability positively influences sustainable e-commerce ecosystems.

Proposition 5: Digital risk management positively influences sustainable e-commerce ecosystems.

2.6 Mediating Role of Digital Capability and Digital Risk Management

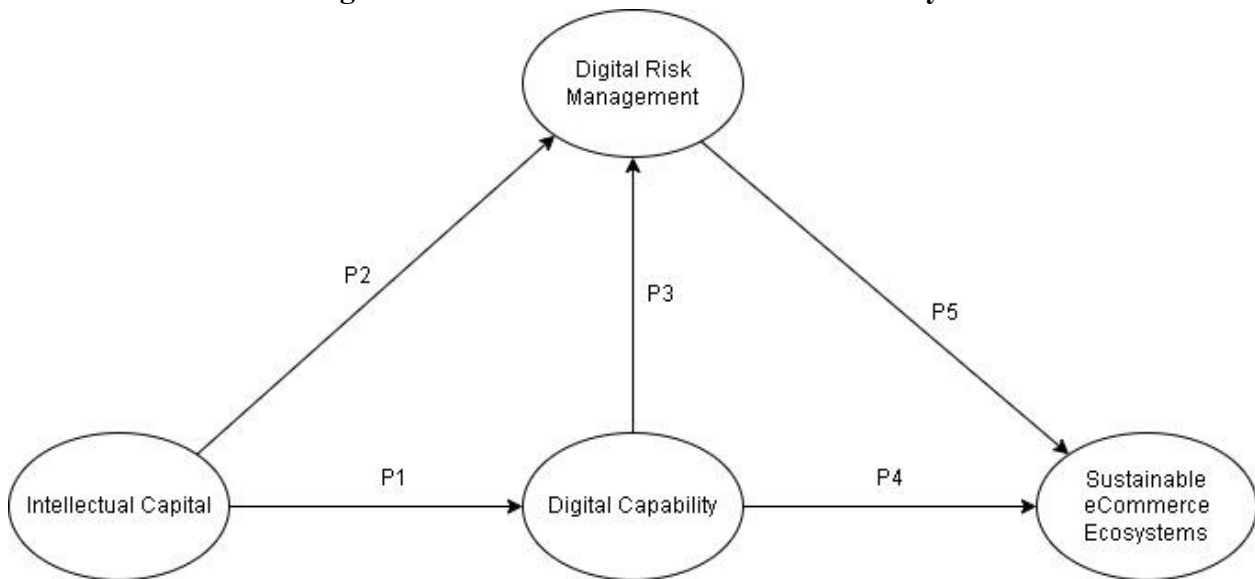
The discussion above suggests that intellectual capital provides the knowledge base that enables SMEs to develop digital capabilities and manage digital risks. These capabilities influence the sustainability of e-commerce ecosystems. Intellectual capital improves firms' ability to learn digital technologies and implement technological innovations. Intellectual capital therefore indirectly supports sustainable digital operations by strengthening digital capability and risk management practices. Therefore, digital capability and digital risk management can act as mediators linking intellectual capital to the sustainability of e-commerce ecosystems.

Proposition 6: Digital capability and digital risk management jointly mediate the relationship between intellectual capital and sustainable e-commerce ecosystems in SMEs.

3. Conceptual Diagram

Based on the propositions, a conceptual diagram is prepared as shown in Figure 1.

Figure 1: Conceptual Framework of Intellectual Capital, Digital Capability, Digital Risk Management and Sustainable E-Commerce Ecosystem



4. Discussion

The study develops a conceptual framework that explains how intellectual capital contributes to the sustainability of e-commerce ecosystems through the development of digital capability and digital risk management in SMEs. The framework uses intellectual capital theory and the knowledge-based view to explain how knowledge resources support technological capabilities and risk management practices in digital business environments. The framework suggests that intellectual capital acts as a key knowledge resource enabling SMEs to build digital capabilities and strengthen digital risk management practices. In knowledge-intensive environments, organizations rely on intangible assets such as expertise and organizational knowledge to generate value. Intellectual capital provides the knowledge base that allows firms to implement digital innovations and develop effective responses to emerging digital risks.

This study argues that intellectual capital contributes to the development of digital capability within SMEs. Digital capability represents the organization’s ability to adopt, integrate, and utilize digital technologies in ways that improve operational efficiency and create value. Firms that possess strong knowledge resources are better positioned to understand technological opportunities and develop the competencies required to use digital tools effectively. In the context of e-commerce, digital capability enables SMEs to participate in digital marketplaces and implement digital business models that enhance competitiveness. The framework also highlights the importance of digital risk management in sustaining digital business operations. As organizations rely more on digital technologies, they become more exposed to cybersecurity threats and data breaches. These risks pose significant challenges for SMEs that depend on digital platforms for their business operations. Effective digital risk management is essential for maintaining the reliability of digital systems. The framework suggests that intellectual capital supports digital risk management by providing the knowledge resources required to understand and address technological vulnerabilities.

Another contribution of the framework is the identification of digital capability as an important mechanism that strengthens digital risk management practices. Organizations that possess strong digital capabilities are better equipped to detect potential vulnerabilities and implement security measures that protect digital

assets. In this sense, digital capability not only enables technological innovation but also enhances the organization's ability to manage risks associated with digital technologies. This relationship illustrates the interdependence between technological capability and risk management in digital environments. The framework also mentions that both digital capability and digital risk management contribute to the sustainability of e-commerce ecosystems. Sustainable e-commerce ecosystems require firms to maintain reliable digital infrastructures, and secure online transactions that support continuous business operations. Digital capability enables organizations to innovate and improve operational efficiency, while digital risk management ensures that digital systems remain secure and resilient against disruptions. Together, these capabilities allow SMEs to participate effectively in digital markets while maintaining the trust of customers and other stakeholders.

Another aspect of the proposed framework is the mediating role of digital capability and digital risk management in linking intellectual capital with sustainable e-commerce ecosystems. Intellectual capital alone may not directly translate into sustainable digital operations unless it is effectively transformed into organizational capabilities. Digital capability and digital risk management act as mechanisms through which knowledge resources are converted into practical outcomes that support sustainable business operations. By highlighting these mediating relationships, the framework explains how knowledge-based resources contribute indirectly to the sustainability of digital ecosystems. The proposed framework also offers insights into the broader transformation of business environments driven by digital technologies. As digital platforms increasingly shape economic activities, organizations must develop new capabilities that allow them to operate effectively within interconnected digital ecosystems. SMEs in particular must rely on knowledge-based resources to build technological competencies and manage digital risks. The framework highlights the importance of intellectual capital as a strategic resource that supports the development of capabilities necessary for digital competitiveness.

Overall, the conceptual framework presented in this study provides a comprehensive perspective on how intellectual capital, digital capability, and digital risk management interact to influence the sustainability of e-commerce ecosystems. By combining these constructs within a single framework, the study contributes to a better understanding of how knowledge-based resources support the development of technological capabilities and risk management practices in SMEs operating in digital markets. The framework emphasizes the importance of transforming knowledge resources into capabilities that enable organizations to manage risks and sustain their participation in digital ecosystems.

5. Theoretical Implications

This study contributes to the literature in many ways. First, the study extends the intellectual capital literature by positioning intellectual capital as a foundational knowledge resource that supports the development of digital capabilities and risk management mechanisms in SMEs. Previous studies have largely examined intellectual capital in relation to firm performance, innovation, and competitive advantage (Nick Bontis, 1998; Mohamed Subramaniam & Mark A. Youndt, 2005). However, limited attention has been paid to how intellectual capital contributes to digital transformation and digital governance within organizations. By linking intellectual capital with digital capability and digital risk management, this study extends the theoretical scope of intellectual capital research in the context of digital business environments. Second, the study adds to the emerging literature on digital capability by emphasizing the role of knowledge-based resources in the development of technological competencies. Digital capability is often examined from the perspective of technological infrastructure or IT resources.

However, the proposed framework indicates that digital capability is not only a technological capability but is also strongly rooted in the knowledge assets embedded in organizations. This perspective aligns with the knowledge-based view of the firm, which emphasizes the importance of knowledge resources in shaping organizational capabilities (Robert M. Grant, 1996). Third, the study extends research on digital risk management by integrating it into a broader framework that connects knowledge resources, technological capability, and sustainability outcomes. Existing studies on digital risk management often focus on cybersecurity practices and technological safeguards. While these aspects are important, they do not fully explain how organizations develop the capability to manage digital risks effectively. The framework suggests that intellectual capital and digital capability jointly influence the development of digital risk management practices. Finally, the study adds to the literature on sustainable e-commerce ecosystems. While digital platforms have significantly transformed business activities, the sustainability of digital ecosystems depends on the ability of participating firms to maintain reliable and secure digital operations. By connecting intellectual capital, digital capability, and digital risk management to sustainable e-commerce ecosystems, the study offers a comprehensive perspective on how SMEs can sustain their participation in digital markets.

6. Practical Implications

The conceptual framework developed in this study also offers several practical implications for managers and policymakers. First, the study emphasizes the strategic importance of intellectual capital in helping SMEs succeed in digital environments. Managers should recognize that investments in employee skills, organizational knowledge systems, and relational networks play a crucial role in building the capabilities required for digital transformation. Developing intellectual capital can strengthen the firm's ability to adopt digital technologies and compete effectively in e-commerce markets. Second, the findings emphasize the importance of developing strong digital capabilities within SMEs. Managers should focus on improving their firms' ability to adopt and use digital technologies by investing in digital infrastructure and training employees in digital skills. Strengthening digital capability can help SMEs improve operational efficiency, increase their presence in digital markets, and adapt to technological changes. Third, the study underscores the importance of digital risk management in ensuring the sustainability of e-commerce operations. As SMEs increasingly rely on digital platforms, they become more vulnerable to cybersecurity threats and digital system disruptions. Managers should therefore implement effective digital risk management practices, including cybersecurity policies and employee awareness programs. These practices can help organizations protect digital assets and maintain the trust of customers and other stakeholders. Finally, policymakers and support institutions should consider the challenges SMEs face in developing digital capabilities and managing digital risks. Government agencies and industry associations support SMEs by providing training programs, digital infrastructure, and advisory services that improve their technological competencies and risk management capabilities. Such initiatives can strengthen the stability and sustainability of digital business ecosystems.

7. Future Research Directions

The framework proposed in this study suggests several directions for future research. First, empirical studies can examine the proposed relationships using survey data collected from SMEs engaged in e-commerce. Quantitative research methods such as structural equation modeling can be used to examine the mediating roles of digital capability and digital risk management that link intellectual capital with

sustainable e-commerce ecosystems. Second, future research may examine additional contextual factors that influence the relationships proposed in this framework. For instance, environmental conditions such as market dynamism, technological turbulence, and competitive intensity may shape how intellectual capital contributes to digital capability and risk management. Examining these contextual factors offer deeper insights into how firms adapt to rapidly changing digital environments. Third, future studies may examine potential moderating variables that influence the relationships in the framework. Organizational characteristics such as firm size, managerial experience, and innovation orientation may affect how SMEs leverage intellectual capital to develop digital capabilities and manage digital risks. Finally, comparative studies across industries and geographical contexts could provide insights into how different institutional environments affect the development of digital capabilities and risk management practices. Such research would extend the applicability of the proposed framework and offer broader insights into sustainable digital ecosystems.

8. Conclusion

This study proposes a conceptual framework explaining how intellectual capital contributes to sustainable e-commerce ecosystems through the development and use of digital capability and digital risk management in SMEs. Based on the knowledge-based view of the firm and intellectual capital theory, the study highlights the role of knowledge-based resources in helping organizations to build technological competencies and manage risks associated with digital business environments. The framework proposes that intellectual capital supports the development of digital capability and digital risk management, which in turn contribute to the sustainability of e-commerce ecosystems. By examining these relationships, the study offers a comprehensive perspective on how SMEs can leverage knowledge resources to strengthen their participation in digital markets while maintaining secure and resilient digital operations. Taken together, the study adds to the literature by integrating intellectual capital, digital capability, and digital risk management into a unified conceptual model that explains the sustainability of e-commerce ecosystems. The framework not only extends theoretical understanding but also offers practical insights for managers and policymakers seeking to support SMEs in the dynamic digital economy.

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