



From Analytics to Agility: How Smart Contract Capability and Supply Chain Digitalization Strengthen Supply Chain Performance in Financial Services

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ABSTRACT

The growing digitalization of financial services has transformed supply chain operations, creating new opportunities to improve responsiveness and organizational performance through advanced data-driven and automation technologies. Despite substantial investments in big data analytics, many financial service organizations continue to struggle to convert analytical insights into agile operational capabilities and sustainable performance improvements. This study develops and empirically tests an integrated framework that explains how Big Data Analytics Capabilities (BAC) contribute to Supply Chain Performance (SCP) through the mediating role of Supply Chain Agility (SCA), while examining the contingent effects of Supply Chain Digitalization (SCD) and Smart Contract Capability (SCC). Data were collected through a structured survey administered to managers from financial institutions, digital banking providers, fintech companies, electronic payment service providers, and financial technology firms. Hierarchical regression analysis and PROCESS bootstrapping techniques were employed to examine the proposed direct, mediating, and moderating relationships. The findings demonstrate that BAC significantly enhances SCA, which subsequently improves SCP, confirming the mediating role of agility. In addition, both SCD and SCC strengthen the positive influence of BAC on SCA as well as the impact of SCA on SCP.

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Introduction

The financial services sector is experiencing rapid digital transformation, fundamentally changing how organizations coordinate operations, exchange information, and create value across interconnected business networks. Unlike traditional supply chains that primarily manage physical goods, financial service supply chains revolve around information flows, digital assets, financial transactions, and technology-enabled services. The widespread adoption of digital banking, fintech platforms, mobile payments, and cloud-based solutions has increased operational complexity, requiring organizations to process massive volumes of heterogeneous data while ensuring security, transparency, regulatory compliance, and operational efficiency. In this environment, effective information coordination has become a critical source of competitive advantage (Queiroz, Telles, and Bonilla 2020; Behl et al. 2024). Consequently, Big Data Analytics Capabilities (BAC) have emerged as a strategic organizational capability, enabling firms to transform large-scale structured and unstructured data into actionable insights that improve decision-making, optimize resource allocation, anticipate risks, and enhance organizational responsiveness, thereby strengthening long-term competitiveness (Bhatti et al. 2024; Wamba et al. 2020). Despite the strategic potential of BAC, many organizations continue to face challenges in transforming analytical insights into tangible operational outcomes. The availability of high-quality data and sophisticated analytical tools does not automatically lead to improved organizational performance. In many cases, valuable insights remain underutilized because business processes are fragmented, information systems lack integration, and decision implementation depends on slow and manually coordinated workflows. Consequently, firms often fail to realize the expected returns from their investments in analytics, highlighting that the value of analytical intelligence depends not only on generating accurate insights but also on an organization's ability to execute timely and coordinated actions (Blome et al. 2013; Wamba et al. 2020).

This challenge is particularly pronounced in financial service supply chains, where operational success depends on rapid decision-making, reliable service delivery, regulatory compliance, and effective coordination among multiple stakeholders. Financial institutions must continuously adapt to evolving customer expectations, technological innovations, market volatility, and increasingly stringent regulatory requirements. Retail research also shows that optimal service and return policies depend on consumer heterogeneity and market conditions (Krishnamoorthy & Sanaei, 2026). Under such dynamic conditions, organizations require capabilities that enable them to rapidly sense environmental changes, reconfigure resources, and respond effectively to emerging opportunities and disruptions. These characteristics are embodied in Supply Chain Agility (SCA), which enables firms to translate analytics-driven insights into responsive operational actions, thereby improving service continuity, reducing operational risks, and enhancing Supply Chain Performance (SCP) (Blome, Schoenherr, and Rexhausen 2013; Gligor, Holcomb, and Stank 2013; Zhou et al. 2024). Accordingly, understanding how organizational capabilities strengthen the relationship between BAC and SCA has become a critical research priority in digital supply chain management.

Building on this perspective, Supply Chain Digitalization (SCD) provides the technological foundation that enables organizations to operationalize analytics-driven decisions across

interconnected business networks (Liu, Q., Zhang, J., & Chen, X. 2026). SCD refers to the extent to which digital technologies are embedded into supply chain processes to facilitate seamless information exchange, real-time visibility, process integration, and collaborative decision-making. In financial service supply chains, digitalization extends beyond the adoption of isolated technologies; it creates an integrated digital ecosystem where financial institutions, payment service providers, fintech firms, regulators, and technology partners can exchange information securely and coordinate operational activities with greater speed and accuracy. Through technologies such as cloud computing, artificial intelligence, application programming interfaces, robotic process automation, and the Internet of Things (IoT), digitally connected organizations reduce information asymmetry, improve process transparency, and enhance cross-organizational collaboration. Consequently, firms with more advanced digitalized supply chains are expected to utilize analytical insights more effectively and develop higher levels of organizational agility (Jum'a, et al. 2025; Behl et al. 2024).

While SCD provides the technological infrastructure for seamless information exchange, organizations also require capabilities that ensure the efficient execution of decisions across interconnected business networks. In this regard, Smart Contract Capability (SCC) has emerged as a strategic organizational capability that enables firms to automate interorganizational processes, improve coordination, and enhance execution efficiency (Robusti et. al 2025). Unlike conventional contracts that rely on manual verification and administrative intervention, smart contracts automatically execute predefined business rules once agreed conditions are fulfilled, thereby reducing processing delays, minimizing human errors, and improving operational consistency while maintaining transparency and compliance (Szabo 1997; Christidis and Devetsikiotis 2016). Rather than viewing smart contracts solely as a blockchain application, this study conceptualizes SCC as an organization's capability to design, integrate, govern, and effectively manage self-executing digital contracts within supply chain operations. Such a capability enables firms to accelerate transaction execution, strengthen collaboration among supply chain partners, and improve the reliability of operational processes. This perspective is particularly relevant in financial service supply chains, where timely transaction processing, regulatory compliance, and trusted information exchange are essential for maintaining operational performance. Consequently, organizations with stronger SCC are expected to translate analytics-driven insights into agile operational responses more effectively, thereby reinforcing the positive impact of BAC on SCA and, ultimately, SCP.

Despite the growing literature on digital transformation and supply chain management, several important research gaps remain. Existing studies have primarily focused on the direct effects of BAC on organizational and SCP, with limited attention given to the organizational mechanisms through which analytics-driven insights are transformed into superior operational outcomes. In particular, empirical evidence regarding the mediating role of SCA in financial service supply chains remains scarce (Bhatti et al. 2024; Zhou et al. 2024). Moreover, while previous research has extensively examined blockchain technology as a means of enhancing transparency, traceability, and information security (Queiroz, Telles, and Bonilla 2020; Bahrami, Shokouhyar, and Seifian 2022), the role of SCC as a distinct organizational capability that improves execution efficiency and interorganizational coordination has received limited

scholarly attention. Furthermore, little is known about how SCD and SCC jointly strengthen the transformation of analytics-driven intelligence into agile supply chain operations (Teece 2007; Wamba et al. 2020). To address these gaps, this study develops an integrated moderated mediation framework grounded in the Dynamic Capabilities perspective. The key contributions of this study are:

- Introducing SCC as a strategic organizational capability, rather than treating it solely as a blockchain application.
- Explaining how SCA mediates the relationship between BAC and SCP in financial service supply chains.
- Demonstrating the complementary moderating roles of SCD and SCC in strengthening the conversion of analytics into agile operational execution and superior SCP.

The remainder of this paper is organized as follows. Section 2 reviews the theoretical foundations and related literature on BAC, SCA, SCD, SCC, and SCP. Section 3 develops the research hypotheses and presents the proposed conceptual framework. Section 4 describes the research methodology, including the research design, measurement development, data collection process, and analytical procedures. Section 5 presents the empirical findings and hypothesis testing results. Section 6 discusses the theoretical contributions, managerial implications, and practical insights derived from the findings. Finally, Section 7 concludes the paper by summarizing the key findings, acknowledging the study's limitations, and suggesting directions for future research.

Literature Review

BAC and SCA

The growing digitalization of financial services has substantially increased the volume, velocity, and diversity of data generated across supply chain activities. Financial institutions continuously process information originating from customers, payment platforms, regulatory agencies, business partners, and digital ecosystems, making data a critical strategic asset for operational decision-making. In such an environment, organizations must possess capabilities that enable them not only to collect large volumes of data but also to transform these data into actionable knowledge that supports rapid and effective responses to market changes. Consequently, BAC have become a fundamental organizational capability for improving supply chain responsiveness and adaptability (Wamba et al. 2017; Dubey, Gunasekaran, and Childe 2019). BAC extends beyond analytical technologies and encompasses the organizational ability to acquire, integrate, process, analyze, and interpret large-scale structured and unstructured data for strategic and operational decision-making (Mikalef et al. 2019). By combining advanced analytical tools with appropriate human expertise and organizational processes, firms can identify emerging market trends, anticipate operational risks, detect anomalies, and generate timely insights that support proactive decision-making. Rather than relying solely on historical information, organizations equipped with strong analytical capabilities can continuously monitor dynamic business environments and improve coordination across interconnected supply chain partners (Bhatti et al. 2024). The strategic value of BAC is particularly evident through its contribution to SCA, which refers to an organization's capability to sense

environmental changes, rapidly adapt operational processes, and respond effectively to unexpected disruptions (Swafford, Ghosh, and Murthy 2006; Gligor, Holcomb, and Stank 2013). In financial service supply chains, agility is reflected in the ability to process transactions efficiently, adjust service operations in real time, respond quickly to regulatory changes, and maintain uninterrupted service delivery despite technological or market uncertainties. Organizations possessing advanced analytical capabilities are better positioned to recognize environmental signals early, evaluate alternative responses, and coordinate timely actions across digitally connected partners, thereby strengthening SCA (Zhang, Wang, and Wang 2025). Prior studies provide strong empirical support for the positive relationship between BAC and SCA. Wamba et al. (2017) argue that organizations with superior analytical capabilities can identify demand fluctuations and operational disruptions more rapidly, enabling faster organizational responses. Similarly, Gunasekaran et al. (2018) demonstrate that real-time analytics enhances supply chain visibility and improves decision quality, allowing firms to allocate resources more efficiently under changing conditions. Drawing upon the Dynamic Capabilities View, Dubey, Gunasekaran, and Childe (2019) further show that BAC strengthens organizational responsiveness, flexibility, and decision speed, all of which represent essential dimensions of SCA. Likewise, Mikalef et al. (2018) emphasize that analytical capabilities create value when organizations effectively integrate analytical insights into operational decision-making processes, enabling knowledge to be translated into agile business actions. Overall, the existing literature consistently indicates that BAC constitutes a critical antecedent of SCA. By enhancing organizational sensing, information processing, and evidence-based decision-making, BAC enable financial service organizations to respond more rapidly and effectively to environmental uncertainty, thereby establishing the theoretical foundation for the following hypothesis.

SCA as a Mediating Mechanism between BAC and SCP

SCP has become a strategic priority for organizations operating in highly dynamic and technology-intensive environments. In financial service supply chains, performance extends beyond traditional operational indicators to include service reliability, transaction accuracy, responsiveness, customer satisfaction, regulatory compliance, and operational efficiency. Achieving these outcomes requires organizations not only to possess valuable analytical resources but also to develop dynamic capabilities that enable rapid adaptation to changing market conditions. Among these capabilities, SCA has been widely recognized as a critical mechanism through which organizations transform strategic resources into superior operational performance (Christopher 2000; Gligor and Holcomb 2012). From the perspective of the Dynamic Capabilities View (DCV), organizational resources generate sustainable performance only when they are effectively deployed through capabilities that enable firms to sense changes, seize emerging opportunities, and rapidly reconfigure operational processes (Teece 2007). In this context, BAC provide organizations with valuable intelligence by improving environmental scanning, demand forecasting, and risk identification. However, analytical insights alone do not directly improve SCP unless they are translated into agile operational responses. SCA serves as the organizational mechanism that converts analytics-driven knowledge into timely decisions,

coordinated actions, and adaptive supply chain processes (Wamba et al. 2017; Mikalef et al. 2019). Previous empirical studies provide substantial evidence supporting this mediating relationship. Dubey, Gunasekaran, and Childe (2019) demonstrated that organizations with stronger analytical capabilities achieve superior performance primarily because analytics enhances supply chain responsiveness, flexibility, and decision speed. Similarly, DeGroote and Marx (2013) argued that agile supply chains enable firms to operationalize analytical insights by responding rapidly to demand fluctuations and environmental disruptions. Wang et al. (2016) further emphasized that agility bridges the gap between analytics-based planning and operational execution, allowing organizations to transform data-driven decisions into measurable performance improvements. Likewise, Papadopoulos et al. (2017) found that the performance benefits of big data analytics largely depend on the extent to which organizations incorporate analytical insights into agile decision-making processes. Collectively, these findings indicate that SCA represents a key dynamic capability through which BAC enhance SCP. In financial service supply chains, agile organizations are better equipped to convert analytical intelligence into responsive operations, improve service quality, strengthen customer responsiveness, and sustain operational excellence. Therefore, SCA is expected to mediate the relationship between BAC and SCP.

SCD and Its Moderating Role

SCD has become a fundamental enabler of organizational competitiveness in digitally connected business environments. Rather than representing the adoption of isolated digital technologies, SCD reflects the extent to which organizations integrate digital solutions into supply chain processes to improve information visibility, process integration, collaboration, and real-time decision-making (Frederico et al. 2020; Queiroz, Telles, and Bonilla 2020). In financial service supply chains, digitalization facilitates seamless coordination among banks, fintech firms, payment service providers, regulators, and technology partners by enabling continuous information exchange, process automation, and end-to-end operational visibility. These capabilities establish the digital foundation required to support responsive and data-driven supply chain operations. The effectiveness of BAC depends not only on the quality of analytical insights but also on the organization's ability to disseminate and operationalize those insights across interconnected supply chain activities. SCD strengthens this process by providing integrated digital infrastructures that facilitate rapid information sharing, system interoperability, and coordinated decision execution (Khalilian & Sanaei, 2026). Organizations with highly digitalized supply chains can more effectively translate analytical intelligence into agile responses because real-time information is readily accessible throughout the network and operational processes are digitally synchronized. Consequently, the positive influence of BAC on SCA is expected to become stronger as the level of SCD increases (Wamba et al. 2017; Mikalef et al. 2018; Bahrami, Shokouhyar, and Seifian 2022). Likewise, Fadler and Legner (2022) argue that digitally integrated supply chains are better positioned to absorb analytical insights and rapidly transform them into coordinated operational actions. SCD also enhances the effectiveness of agile supply chain capabilities in generating superior organizational performance. Although agile organizations can rapidly adapt to environmental changes, the performance benefits of agility are maximized when supported by integrated digital platforms

that enable real-time communication, process transparency, and synchronized execution. Digital technologies reduce information latency, improve cross-functional coordination, and accelerate organizational responses to customer requirements and market disruptions, thereby amplifying the impact of agility on operational performance (Gligor and Holcomb 2012; Blome, Schoenherr, and Rexhausen 2013). Empirical evidence further indicates that digitalized supply chains achieve higher levels of service quality, operational efficiency, and customer responsiveness because digital infrastructures enable agile decisions to be implemented more rapidly and consistently (Atieh Ali et al. 2024; Jum'a, Zighan, and Alkalha 2025; Schoenherr and Speier-Pero 2015). Therefore, SCD is expected to strengthen both the relationship between BAC and SCA and the relationship between SCA and SCP.

SCC and Its Moderating Role

The growing complexity of digital business ecosystems has shifted organizational priorities from information sharing toward intelligent execution of interorganizational processes. While digitalization enables organizations to exchange information efficiently, achieving superior operational performance also depends on the ability to execute decisions rapidly, accurately, and consistently across multiple supply chain partners. In this context, SCC has emerged as a strategic organizational capability that enables firms to automate contractual processes, coordinate transactions, and improve operational efficiency through self-executing digital agreements (Szabo 1997; Christidis and Devetsikiotis 2016). Unlike conventional contracts, which often require manual verification, administrative intervention, and sequential approval procedures, smart contracts automatically execute predefined business rules once specified conditions are satisfied. This automation reduces transaction delays, minimizes human errors, enhances process transparency, and improves execution consistency across organizational boundaries. However, the organizational benefits of smart contracts depend not merely on the underlying technology but on an organization's capability to design, integrate, govern, and continuously manage smart contract solutions within its operational processes. Accordingly, this study conceptualizes SCC as a higher-order organizational capability rather than a simple technological adoption variable. From the perspective of the Dynamic Capabilities View, SCC complements BAC by strengthening the organization's ability to transform analytical insights into coordinated operational actions. While BAC enables firms to identify opportunities, anticipate risks, and generate data-driven recommendations, SCC ensures that these decisions are implemented efficiently through automated execution mechanisms. In financial service supply chains, where transaction speed, operational accuracy, regulatory compliance, and trusted collaboration are critical, organizations possessing stronger SCC can respond more rapidly to changing business conditions while reducing coordination costs and execution uncertainty. Consequently, SCC is expected to reinforce the positive influence of BAC on SCA by enabling faster and more reliable implementation of analytics-driven decisions (Teece 2007; Wamba et al. 2020). SCC also enhances the performance outcomes of agile supply chains. Agile organizations continuously adapt their operations in response to environmental changes; however, the benefits of agility are maximized when operational responses can be executed automatically, consistently, and with minimal administrative delays. By streamlining

transaction execution, improving interorganizational trust, and reducing process inefficiencies, SCC enables agile organizations to achieve higher levels of operational efficiency, service reliability, and customer responsiveness. Therefore, organizations with stronger SCC are better positioned to convert agile supply chain practices into superior SCP. Accordingly, SCC is expected to positively moderate both the relationship between BAC and SCA and the relationship between SCA and SCP.

Research Gap

The existing literature has substantially advanced the understanding of how digital technologies contribute to supply chain management and organizational performance. Previous studies have demonstrated the strategic importance of BAC in improving decision quality, enhancing organizational responsiveness, and supporting SCP. Likewise, SCA has been widely recognized as a critical dynamic capability that enables organizations to respond effectively to environmental uncertainty, while SCD has been identified as an important enabler of information integration and operational coordination (Wamba et al. 2017; Mikalef et al. 2019; Queiroz, Telles, and Bonilla 2020). Despite these advances, several important research gaps remain. First, most existing studies have focused on the direct performance outcomes of BAC, providing limited explanation of the organizational mechanisms through which analytics-driven insights are transformed into superior SCP. In particular, empirical evidence regarding the mediating role of SCA in financial service supply chains remains limited (Bhatti et al. 2024; Zhou et al. 2024). Second, although digital transformation has become a major research stream, previous studies have primarily emphasized technological adoption rather than the complementary organizational capabilities required to convert digital intelligence into effective operational execution. Third, research on blockchain has largely concentrated on transparency, traceability, and security, whereas the strategic role of SCC as an organizational capability that automates execution, strengthens coordination, and enhances organizational responsiveness has received comparatively little attention (Bahrami, Shokouhyar, and Seifian 2022; Christidis and Devetsikiotis 2016). Finally, limited empirical research has simultaneously examined how SCD and SCC interact to strengthen the transformation of analytics-driven insights into agile operations and, ultimately, superior SCP. To address these gaps, this study develops an integrated moderated mediation framework grounded in the Dynamic Capabilities View. Specifically, it investigates the mediating role of SCA in linking BAC to SCP while examining the complementary moderating roles of SCD and SCC. By extending the analysis to financial service supply chains, this study contributes to a deeper understanding of how complementary digital capabilities collectively enable organizations to transform analytical intelligence into agile execution and sustainable operational performance.

Hypothesis Development

BAC and SCA

BAC have become a critical organizational capability for firms operating in data-intensive business environments. Rather than representing the mere adoption of analytical technologies, BAC reflects an organization's ability to acquire, integrate, process, analyze, and utilize large volumes of structured and unstructured data to support strategic and operational decision-

making (Mikalef et al. 2018). In financial service supply chains, where vast amounts of transactional, customer, operational, and regulatory data are generated continuously, these capabilities enable organizations to extract actionable insights that improve decision quality, reduce uncertainty, and enhance responsiveness to rapidly changing market conditions (Gandomi and Haider 2015; Wamba et al. 2017). The Dynamic Capabilities View (DCV) provides a strong theoretical foundation for explaining the relationship between BAC and SCA. According to DCV, organizations achieve sustainable competitive advantage not simply by possessing valuable resources, but by developing capabilities that enable them to sense environmental changes, seize emerging opportunities, and continuously reconfigure organizational resources in response to dynamic business conditions (Teece 2007; Eisenhardt and Martin 2000). Within this perspective, BAC primarily enhances an organization's sensing capability by providing timely, accurate, and data-driven insights regarding customer behavior, operational risks, demand fluctuations, and market uncertainty. However, these insights create value only when organizations can rapidly translate them into operational decisions and coordinated responses across the supply chain. SCA represents this adaptive capability. It reflects an organization's ability to rapidly detect environmental changes, adjust operational processes, coordinate resources, and respond effectively to unexpected disruptions or emerging opportunities (Swafield, Ghosh, and Murthy 2006; Gligor, Holcomb, and Stank 2013). In financial service supply chains, agility is reflected in the ability to respond quickly to evolving customer requirements, regulatory changes, cyber-security threats, and fluctuations in digital financial markets while maintaining reliable and uninterrupted service delivery.

Previous empirical studies consistently support the positive relationship between BAC and SCA. Wamba et al. (2017) found that organizations with advanced analytical capabilities exhibit greater responsiveness because they can identify operational disruptions and market changes more quickly. Similarly, Gunasekaran et al. (2018) reported that real-time analytics improves supply chain visibility and accelerates decision-making, enabling firms to respond more effectively to changing customer demands. Likewise, Zhang, Wang, and Wang (2025) demonstrated that organizations leveraging advanced analytics are better able to anticipate disruptions and implement timely operational adjustments. These findings suggest that BAC enhances agility by improving organizational visibility, accelerating information processing, strengthening cross-functional coordination, and supporting proactive rather than reactive decision-making. Drawing upon the Dynamic Capabilities View and the accumulated empirical evidence, organizations possessing stronger BAC are expected to develop higher levels of SCA by sensing changes more rapidly and transforming analytical intelligence into coordinated operational responses. Therefore, the following hypothesis is proposed:

H1: *BAC positively influence SCA.*

SCA, SCP, and the Mediating Role of SCA

SCP reflects an organization's ability to achieve superior operational and strategic outcomes through effective coordination of supply chain activities. In financial service supply chains, performance extends beyond traditional efficiency measures and encompasses service reliability, transaction accuracy, customer responsiveness, regulatory compliance, operational

flexibility, and process efficiency. As financial institutions operate in increasingly volatile and technology-driven environments, sustaining high levels of performance requires organizations to rapidly adapt their operations while maintaining service continuity and customer trust (Christopher 2000; Gligor and Holcomb 2012). SCA has been widely recognized as one of the most important organizational capabilities for achieving these objectives. Agility enables organizations to sense environmental changes, rapidly reconfigure operational resources, and respond effectively to unexpected events without compromising operational quality. In financial service supply chains, agile organizations can quickly adjust to changing customer expectations, evolving regulatory requirements, technological disruptions, and cyber-security threats while ensuring uninterrupted service delivery. Such responsiveness improves operational efficiency, strengthens customer satisfaction, minimizes service disruptions, and ultimately enhances overall SCP (Blome, Schoenherr, and Rexhausen 2013; Gligor, Holcomb, and Stank 2013). The positive relationship between SCA and organizational performance is strongly supported by the Dynamic Capabilities View (DCV). According to this perspective, organizational resources create sustainable value only when firms possess capabilities that allow them to continuously adapt to changing business environments (Teece 2007). Agility represents one of these higher-order capabilities because it enables organizations to transform available resources and information into coordinated operational actions that improve organizational outcomes. Rather than being an end in itself, agility serves as the mechanism through which organizations convert strategic capabilities into measurable performance improvements. Empirical evidence consistently supports this argument. Swafford, Ghosh, and Murthy (2006) demonstrated that agile supply chains achieve superior operational performance by responding more effectively to market uncertainty. Similarly, Gligor and Holcomb (2012) found that SCA significantly improves customer responsiveness and organizational effectiveness. Blome, Schoenherr, and Rexhausen (2013) further showed that agile organizations are more resilient to environmental disruptions and therefore sustain higher levels of operational performance. More recently, Zhou et al. (2024) confirmed that agility plays an essential role in enhancing SCP under rapidly changing business conditions. Beyond its direct influence on performance, SCA also represents the primary mechanism through which BAC create organizational value. Although BAC enables firms to collect, integrate, and analyze vast amounts of data, analytical insights alone cannot improve performance unless they are translated into rapid and coordinated operational responses. Agility bridges this gap by allowing organizations to transform data-driven knowledge into flexible operational decisions, faster resource reconfiguration, and responsive service delivery. Consequently, BAC contributes to superior SCP not only directly but also indirectly through its positive effect on SCA. This mediating perspective is consistent with the Dynamic Capabilities View, which argues that organizational capabilities generate competitive advantage by enabling firms to effectively deploy valuable resources in dynamic environments (Teece 2007; Wamba et al. 2017; Mikalef et al. 2019). Based on the above theoretical arguments and empirical evidence, the following hypotheses are proposed:

H2: *SCA positively influences SCP.*

H3: *SCA mediates the relationship between BAC and SCP.*

The Moderating Role of SCD

SCD has fundamentally transformed the way organizations coordinate activities, exchange information, and execute business processes across supply chain networks. Rather than representing the isolated adoption of digital technologies, SCD reflects the integration of digital platforms, intelligent information systems, cloud computing, artificial intelligence, Internet of Things (IoT), and application programming interfaces into supply chain operations to facilitate real-time information sharing, process synchronization, and collaborative decision-making (Frederico et al. 2020; Queiroz, Telles, and Bonilla 2020). In financial service supply chains, digitalization enables seamless interaction among banks, fintech firms, payment service providers, regulators, and technology partners, thereby improving visibility, connectivity, and operational coordination. From the perspective of the Dynamic Capabilities View (DCV), digitalization does not independently create superior organizational performance; rather, it enhances the effectiveness of existing organizational capabilities by enabling faster information processing and more efficient resource orchestration (Teece 2007). Accordingly, the organizational value of BAC depends on the extent to which analytical insights can be rapidly disseminated and implemented throughout the supply chain. Organizations with highly digitalized supply chains possess integrated digital infrastructures that facilitate real-time data exchange, cross-functional collaboration, and synchronized decision execution. These characteristics enable managers to transform analytics-driven insights into coordinated operational responses more efficiently than organizations operating in fragmented digital environments. Therefore, the positive influence of BAC on SCA is expected to be stronger when the level of SCD is high (Wamba et al. 2017; Mikalef et al. 2018; Bahrami, Shokouhyar, and Seifian 2022). SCD is also expected to strengthen the relationship between SCA and SCP. Although agile organizations can rapidly sense environmental changes and adjust their operations, translating these adaptive responses into superior performance requires digital infrastructures that support real-time communication, integrated workflows, and efficient execution across organizational boundaries. In financial service supply chains, digital platforms enable agile decisions to be implemented more quickly through automated information sharing, synchronized operational processes, and continuous coordination among ecosystem partners. Consequently, organizations operating in highly digitalized environments can achieve greater operational efficiency, service reliability, customer responsiveness, and regulatory compliance than firms with lower levels of digital integration (Blome, Schoenherr, and Rexhausen 2013; Schoenherr and Speier-Pero 2015; Atieh Ali et al. 2024; Jum'a, Zighan, and Alkalha 2025). Taken together, these arguments suggest that SCD acts as a complementary organizational capability that amplifies the benefits of both analytical capabilities and SCA. By facilitating information integration, accelerating organizational coordination, and supporting timely execution of operational decisions, SCD strengthens the transformation of analytical intelligence into agile actions and enhances the ability of agile supply chains to achieve superior performance. Therefore, the following hypotheses are proposed:

H4: *SCD positively moderates the relationship between BAC and SCA, such that the relationship is stronger at higher levels of SCD.*

H5: *SCD positively moderates the relationship between SCA and SCP, such that the relationship is stronger at higher levels of SCD.*

The Moderating Role of SCC

While SCD establishes the digital infrastructure necessary for information integration, organizations also require capabilities that ensure the rapid and reliable execution of decisions across interconnected supply chain partners. In digitally intensive environments, generating analytical insights alone is insufficient unless those insights can be translated into timely operational actions. SCC addresses this challenge by enabling organizations to design, deploy, integrate, and govern self-executing digital contracts that automate business processes and coordinate interorganizational transactions with minimal human intervention (Szabo 1997; Christidis and Devetsikiotis 2016). Unlike traditional contractual mechanisms that depend on manual verification, sequential approvals, and administrative coordination, smart contracts automatically execute predefined business rules once contractual conditions are satisfied. However, the organizational value of smart contracts depends not merely on their technological implementation but on an organization's capability to effectively incorporate them into operational processes, align them with business objectives, and continuously manage their execution. Accordingly, this study conceptualizes SCC as a higher-order organizational capability that strengthens execution quality, enhances operational coordination, and improves organizational responsiveness. Drawing upon the Dynamic Capabilities View (Teece 2007), SCC complements BAC by improving an organization's ability to convert analytical intelligence into coordinated operational actions. Although BAC enables firms to identify emerging opportunities, forecast risks, and generate data-driven recommendations, the realization of these benefits depends on how efficiently decisions are implemented throughout the supply chain. Organizations possessing stronger SCC can automate transaction execution, reduce process delays, eliminate unnecessary manual interventions, and improve coordination among supply chain partners. In financial service supply chains, where thousands of transactions are processed continuously under strict regulatory requirements, these capabilities enable organizations to respond more rapidly to market changes while maintaining accuracy, transparency, and compliance. Consequently, SCC is expected to strengthen the positive relationship between BAC and SCA by accelerating the implementation of analytics-driven decisions and reducing execution uncertainty (Wamba et al. 2020). SCC is also expected to enhance the performance benefits generated by SCA. Agile organizations continuously adapt their operations to changing customer expectations, technological developments, and regulatory requirements. Nevertheless, agile decision-making alone does not guarantee superior performance if execution remains slow, fragmented, or dependent on manual coordination. Smart contracts enable agile organizations to operationalize their responses through automated workflows, real-time transaction validation, standardized contractual enforcement, and transparent interorganizational coordination. These characteristics reduce operational risks, improve process reliability, shorten service delivery cycles, and enhance customer satisfaction. Within financial service supply chains, where transaction speed and operational accuracy directly influence organizational performance, firms with stronger SCC are therefore expected to derive greater performance benefits from their agility than organizations with weaker

execution capabilities. Overall, SCC functions as a complementary dynamic capability that bridges the gap between decision-making and execution. By automating contractual processes, strengthening interorganizational coordination, and improving execution efficiency, SCC amplifies the organizational value of both analytical capabilities and SCA. Therefore, the following hypotheses are proposed:

H6: *SCC positively moderates the relationship between BAC and SCA, such that the relationship is stronger when SCC is high.*

H7: *SCC positively moderates the relationship between SCA and SCP, such that the relationship is stronger when SCC is high.*

Conceptual Framework and Summary of Hypotheses

Drawing upon the Dynamic Capabilities View (DCV), this study proposes an integrated moderated mediation framework to explain how analytical capabilities are transformed into superior SCP within financial service supply chains. The framework argues that BAC provide organizations with the ability to acquire, process, and interpret large volumes of data, thereby enhancing their capacity to identify opportunities, anticipate risks, and support evidence-based decision-making. However, the value of these analytical capabilities is not realized automatically. Instead, organizations must possess dynamic capabilities that enable them to rapidly translate analytical intelligence into coordinated operational actions. Accordingly, SCA is positioned as the central mediating mechanism linking BAC to SCP. Organizations equipped with superior analytical capabilities are expected to develop greater agility by improving environmental sensing, accelerating decision-making, and enhancing operational responsiveness. This increased agility subsequently enables firms to achieve higher levels of operational efficiency, service quality, customer responsiveness, and overall SCP. The framework further proposes that the effectiveness of this transformation process depends on two complementary organizational capabilities. SCD provides the digital infrastructure that facilitates real-time information sharing, process integration, and coordinated decision execution across the supply chain. In parallel, SCC strengthens execution efficiency by automating contractual processes, reducing coordination delays, and ensuring reliable implementation of operational decisions. Together, these complementary capabilities enhance the conversion of analytics-driven intelligence into agile operations and amplify the performance benefits generated by organizational agility. Based on these theoretical arguments, the proposed conceptual framework incorporates one direct relationship, one mediating relationship, and four moderating relationships, resulting in the seven hypotheses presented above. Fig. 1 illustrates the complete research model and summarizes the hypothesized relationships examined in this study.

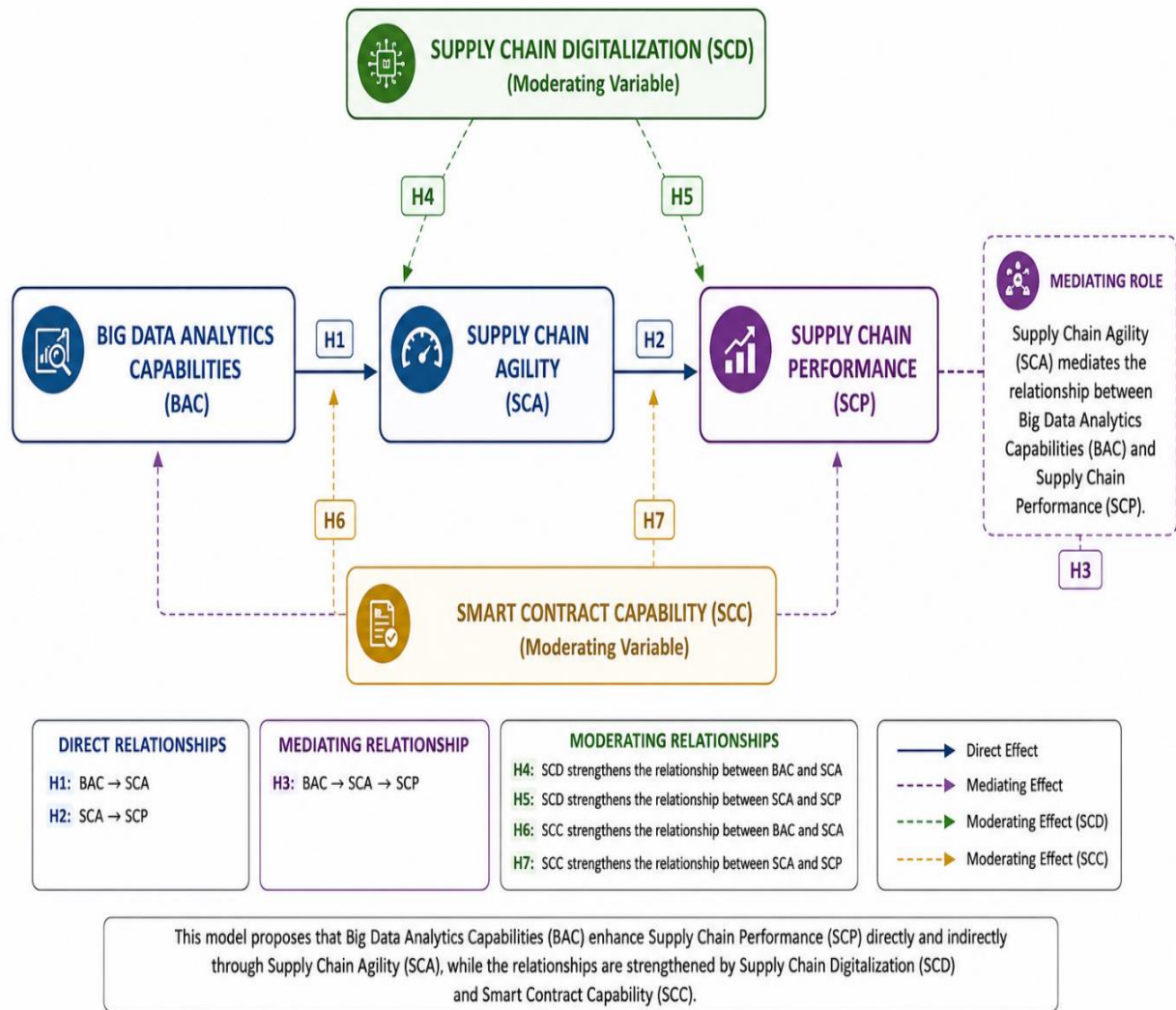


Fig 1. The conceptual model

Methods and data

Sample and Data Collection

The empirical data for this study were collected from organizations operating within Iran's financial services value chain between **September 2024** and **April 2025**. Unlike traditional manufacturing value chains that primarily manage the flow of physical products, financial services value chains coordinate the exchange of financial transactions, digital information, regulatory documentation, payment services, and technology-enabled financial solutions among multiple interconnected organizations. Consequently, operational performance increasingly depends on effective information sharing, digital integration, rapid decision-making, and intelligent process execution. The target population consisted of commercial banks, private financial institutions, payment service providers (PSPs), fintech companies, digital payment firms, insurance companies offering digital services, and financial technology solution providers. These organizations represent the most digitally advanced

segment of Iran's financial sector and extensively utilize digital technologies to coordinate business processes and service delivery across organizational boundaries.

To identify eligible participants, an initial screening was conducted using official company websites, annual reports, digital transformation initiatives, and publicly available information regarding technology adoption. Organizations were considered eligible if they had demonstrated investments in BAC, SCD, or SCC to improve operational coordination, information sharing, workflow automation, and service performance. Following this screening process, 146 organizations met the selection criteria and were included in the sampling frame. Structured questionnaires were distributed to senior and middle managers responsible for operations, digital transformation, information technology, business analytics, innovation management, and value chain coordination. These respondents were selected because of their direct involvement in organizational digital initiatives and operational decision-making. In total, 278 questionnaires were distributed across the participating organizations. At the conclusion of the data collection period, 183 valid questionnaires were returned and retained for statistical analysis, representing a 65.8% valid response rate.

To improve data quality and align the survey with the conceptual framework, the questionnaire was organized into three thematic sections. The first section measured BAC by assessing organizational capabilities related to data acquisition, integration, analytics infrastructure, and evidence-based decision-making. The second section evaluated SCA and SCP by measuring organizational responsiveness, operational flexibility, service continuity, customer responsiveness, and overall operational effectiveness within financial services value chains. The final section assessed SCD and SCC by examining digital process integration, interorganizational information sharing, workflow automation, and organizations' capability to implement and manage smart contract-enabled business processes.

Prior to the main survey, a pilot study involving 25 experienced managers was conducted to evaluate the clarity, reliability, and content validity of the measurement instrument. Feedback obtained during the pilot phase was incorporated to refine questionnaire wording, improve construct clarity, and ensure consistency with the study's conceptual framework, following the methodological recommendations of Ismail, Kinchin, and Edwards (2018).

Several procedural measures were implemented to maximize response quality. Participants received a detailed explanation of the study's objectives and were assured that all responses would remain anonymous and confidential in accordance with established ethical research practices. Four follow-up reminder emails accompanied by appreciation messages were distributed throughout the data collection period to encourage participation (Saunders, 2012). Finally, potential non-response bias was assessed by comparing early and late respondents using independent-sample t-tests across all principal constructs, including BAC, SCA, SCP, SCD, and SCC. No statistically significant differences were identified, indicating that non-response bias is unlikely to affect the validity of the study's findings (Rogelberg and Stanton, 2007).

Measures

All constructs were measured using a five-point Likert scale ranging from 1 ("Strongly Disagree") to 5 ("Strongly Agree"). Measurement items were adapted from well-established scales reported in previous studies and subsequently refined to reflect the operational characteristics of financial service supply chains. BAC were measured using the scale developed by Bhatti et al. (2024), which evaluates an organization's ability to acquire, integrate, process, and utilize large volumes of data to support operational and strategic decision-making. The measurement items capture dimensions such as analytics infrastructure, data quality, real-time analytics, and analytical decision support. SCA was measured using the instrument proposed by Zhou et al. (2024), focusing on an organization's capability to rapidly sense environmental changes, respond to unexpected disruptions, reconfigure operational processes, and maintain service continuity under dynamic market conditions. SCP was assessed using the measurement scale adapted from Zhou et al. (2023). The instrument evaluates operational efficiency, service reliability, customer satisfaction, responsiveness, process effectiveness, and overall SCP within financial service organizations. SCD was measured using the scale proposed by Jum'a, Zighan, and Alkalha (2025), which assesses the extent to which organizations integrate digital technologies into supply chain processes. The measurement items capture digital connectivity, information integration, automation, system interoperability, and real-time visibility across organizational activities. SCC was measured using measurement items adapted from Sharma (2025) and refined to reflect the capability perspective adopted in this study. Rather than measuring simple technology adoption, the instrument evaluates an organization's capability to design, integrate, deploy, govern, and manage smart contract solutions that automate contractual execution, improve interorganizational coordination, enhance transaction reliability, and support operational efficiency across financial service supply chains. All measurement instruments were reviewed by academic experts and industry practitioners before data collection and were pilot-tested to ensure contextual relevance, content validity, and conceptual clarity. Minor wording modifications were introduced to improve readability and align the measurement items with the operational characteristics of the financial services sector while preserving the theoretical meaning of the original constructs.

Control Variables

To isolate the effects of the proposed research model and reduce the influence of extraneous factors, several control variables were incorporated into the analysis. These variables have been widely recognized in prior research as potential determinants of organizational capabilities and SCP.

First, managerial work experience was controlled because experienced managers generally possess greater expertise in implementing digital transformation initiatives, utilizing advanced analytics, and coordinating organizational change. Managers with extensive professional experience are more capable of integrating data-driven insights into operational decision-making and facilitating the adoption of digital capabilities that enhance SCA and performance. Second, the geographical location of the organization was included as a control variable. Regional differences may influence access to digital infrastructure, technology providers, skilled professionals, and institutional support, thereby affecting the development of BAC, SCD, and SCC. Organizations located in major financial and commercial centers are generally

exposed to more advanced digital ecosystems and innovation opportunities (Justo, DeTienne, and Sieger 2015). Third, respondents' educational level was controlled because higher educational attainment is associated with stronger analytical competencies, greater familiarity with digital technologies, and a higher capacity to support organizational innovation. Education was measured using a seven-point scale ranging from 1 (less than high school) to 7 (doctoral degree), following the approach of DeTienne and Cardon (2012). Fourth, organizational age was included as a control variable. Older organizations often possess more established operational routines, accumulated organizational knowledge, and mature governance structures that may influence their ability to deploy analytical capabilities, implement digital technologies, and improve SCP (Justo, DeTienne, and Sieger 2015). Fifth, operational scope (local, national, or international) was controlled because organizations operating across broader markets typically manage more complex business networks and therefore require greater digital integration, coordination capabilities, and operational flexibility. Such differences may influence both the adoption of digital capabilities and organizational performance (Behl et al. 2024). Finally, firm size, measured by the number of employees, was incorporated as a control variable. Larger financial service organizations generally possess greater financial resources, technological infrastructure, and managerial capabilities to invest in digital transformation, advanced analytics, and intelligent automation. Conversely, smaller organizations may exhibit greater operational flexibility but often face resource constraints that limit large-scale digital initiatives (DeTienne and Cardon 2012).

Common Method Bias

Because all study constructs, including BAC, SCA, SCP, SCD, and SCC, were measured using responses from the same participants, the potential for common method bias (CMB) was carefully evaluated. Following the recommendations of Podsakoff et al. (2003) and Podsakoff and Organ (1986), both procedural and statistical remedies were employed to minimize this concern. At the questionnaire design stage, several procedural techniques were implemented. Participants were assured that their responses would remain anonymous and confidential, reducing evaluation apprehension and social desirability bias. The questionnaire was carefully organized to create psychological separation between predictor and criterion constructs, while clear instructions and concise wording were used to reduce ambiguity and respondent fatigue. Furthermore, demographic information was collected separately from the main measurement items, helping to minimize consistency bias (Krishnan, Martin, and Noorderhaven 2006). Following data collection, Harman's single-factor test was conducted as an initial statistical assessment of common method variance. All measurement items were entered into an exploratory factor analysis using an unrotated principal component solution. The first factor accounted for **22.69%** of the total variance, which is substantially below the commonly accepted threshold of **50%**, indicating that common method bias is unlikely to represent a serious concern (Podsakoff and Organ 1986). To further verify this conclusion, a confirmatory factor analysis (CFA) was performed by specifying a single-factor measurement model in which all observed indicators loaded onto one latent construct. The resulting model demonstrated poor overall fit, indicating that a single latent factor could not adequately explain

the covariance among the measurement items. Collectively, these procedural and statistical assessments provide strong evidence that common method bias does not materially influence the empirical findings of this study.

Measurement Model Assessment

Before testing the structural model, the reliability and validity of the measurement model were assessed following the recommendations of Hair et al. (2022). Internal consistency reliability was evaluated using Cronbach's Alpha (CA) and Composite Reliability (CR), whereas convergent validity was assessed using the Average Variance Extracted (AVE). As presented in Table 1, all constructs exceeded the recommended thresholds. Cronbach's Alpha values ranged from 0.882 to 0.921, while Composite Reliability values varied between 0.914 and 0.941, indicating excellent internal consistency. Likewise, all AVE values ranged from 0.680 to 0.727, exceeding the recommended threshold of 0.50 and confirming satisfactory convergent validity.

Table 1. Reliability and Convergent Validity Assessment

Construct	Cronbach's Alpha	Composite Reliability	AVE
BAC	0.914	0.933	0.699
SCA	0.902	0.927	0.718
SCD	0.890	0.920	0.697
SCC	0.882	0.914	0.680
SCP	0.921	0.941	0.727

Discriminant validity was subsequently assessed using both the Fornell–Larcker criterion and the Heterotrait–Monotrait Ratio (HTMT). The square root of the AVE for every construct was greater than its correlations with the remaining constructs, satisfying the Fornell–Larcker criterion. In addition, all HTMT values were below the recommended threshold of 0.85, with the highest observed value equal to 0.721, confirming adequate discriminant validity among the study constructs.

Finally, multicollinearity was examined using the Variance Inflation Factor (VIF). All predictor constructs reported VIF values ranging from 1.94 to 2.31, well below the recommended cutoff value of 3.30, indicating that multicollinearity was not a concern. Collectively, these results confirm that the measurement model demonstrates satisfactory reliability, convergent validity, discriminant validity, and collinearity diagnostics, supporting the suitability of the constructs for subsequent structural model analysis.

Results

5.1. Descriptive Statistics and Correlation Analysis

This study examines the relationships among BAC, SCA, SCD, SCC, and SCP within financial service organizations. Hierarchical regression analysis and PROCESS Macro (Model 4 and Model 1) were employed to test the proposed direct, mediating, and moderating relationships. The analyses were performed using SPSS 29 with **10,000** bootstrap resamples while controlling

for respondents' work experience, geographical location, education level, organizational age, operational scope, and firm size.

Table 2 presents the descriptive statistics and Pearson correlation coefficients for all study variables. Overall, the descriptive statistics indicate relatively high levels of digital capability adoption among the sampled organizations. BAC recorded a mean score of 4.18 (SD = 0.71), indicating that the sampled financial service organizations have widely adopted data analytics to support strategic and operational decision-making. SCD achieved the highest mean ($M = 4.29$, $SD = 0.62$), reflecting the sector's ongoing digital transformation. SCA and SCP also showed relatively high levels ($M = 4.11$, $SD = 0.69$; $M = 4.16$, $SD = 0.66$, respectively), while SCC reported a slightly lower mean ($M = 3.94$, $SD = 0.73$), suggesting that its adoption is still evolving. The correlation analysis provides initial support for the proposed conceptual framework. BAC was positively associated with SCA ($r = 0.57$, $p < 0.001$), SCP ($r = 0.41$, $p < 0.001$), SCD ($r = 0.52$, $p < 0.001$), and SCC ($r = 0.46$, $p < 0.001$), indicating that organizations with stronger analytical capabilities also tend to possess more advanced digital and execution capabilities. SCA demonstrated the strongest correlation with SCP ($r = 0.63$, $p < 0.001$), highlighting agility as a key driver of SCP. Moreover, SCA was positively correlated with both SCD ($r = 0.49$, $p < 0.001$) and SCC ($r = 0.44$, $p < 0.001$), suggesting that digital integration and intelligent contract execution jointly support organizational responsiveness. SCD and SCC were also positively related ($r = 0.48$, $p < 0.001$) and both exhibited significant positive associations with SCP ($r = 0.51$ and $r = 0.47$, respectively; $p < 0.001$). In contrast, all control variables showed relatively weak correlations with the principal constructs (all $r < 0.16$). Furthermore, the highest observed correlation ($r = 0.63$) remained well below the accepted multicollinearity threshold ($r = 0.80$), indicating that multicollinearity is not a concern in the present study.

Table 2: Descriptive statistics and correlations.

	Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11
1	BAC	4.18	0.71	1										
2	SCA	4.11	0.69	0.57***	1									
3	SCC	3.94	0.73	0.46***	0.44***	1								
4	SCD	4.29	0.62	0.52***	0.49***	0.48***	1							
5	SCP	4.16	0.66	0.41***	0.63***	0.47***	0.51***	1						
6	Work Experience	8.2	5.7	0.07	0.05	0.06	0.04	0.05	1					
7	Area	-	-	0.03	0.02	0.01	0.02	0.02	0.08	1				
8	Education	5.11	1.14	0.09	0.08	0.07	0.06	0.06	0.14*	0.07	1			
9	Organization Age	16.8	8.3	0.06	0.04	0.05	0.07	0.05	0.10	0.09	0.08	1		

Table 2: Descriptive statistics and correlations.

	Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11
10	Operational Scope	2.34	0.71	0.08	0.06	0.05	0.08	0.07	0.12*	0.05	0.07	0.11	1	
11	Firm Size	214	118	0.10	0.09	0.08	0.11	0.09	0.16*	0.09	0.10	0.14*	0.12	1

*p < 0.1, **p < 0.05, ***p < 0.01

Hierarchical Regression Results for SCP

Table 3 presents the hierarchical regression results for SCP. The regression models were estimated sequentially to examine the direct effect of BAC, the mediating role of SCA, and the moderating effects of SCD and SCC.

Table 3. Regression result

Variables		SCA					SCP					M1
Model	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10		1
Control Variables												
Work Experience	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.02	0.02		0.02
Area	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.01
Education	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04		0.04
Organization Age	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02		0.02
Operational Scope	0.05	0.05	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04		0.04
Firm Size	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05		0.04
Main Effects												
BAC		0.48**										
		*	0.12*	0.11*	0.10*	0.09*	0.08	0.07	0.08	0.07		0.06
SCA			0.42***	0.40***	0.39***		0.42***	0.38***	0.37***	0.36***		0.35
SCD				0.21**	0.18**				0.16**			0.16
SCC					0.23***					0.20***		0.18

Interaction Terms												
BAC × SCD			0.20**		0.18**							
BAC × SCC				0.24***	0.22***							
SCA × SCD						0.17**		0.16**				
SCA × SCC							0.22***	0.20***				
Model Fit												
R ²	0.05	0.18	0.43	0.47	0.49	0.44	0.47	0.49	0.52	0.55		0.57
Adjusted R ²	0.03	0.16	0.41	0.45	0.47	0.42	0.45	0.47	0.50	0.53		0.55

Table 3. Regression result

Variables		SCA					SCP				
Model	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
ANOVA	1.7	9.86**	22.41**	23.96**	25.14**	23.27**	24.95**	26.08**	27.71**	29.62**	31.1
F	4	*	*	*	*	*	*	*	*	*	5***

Standardized Beta Coefficients; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Model 1 included only the control variables predicting SCA. The model explained a limited proportion of variance ($R^2 = 0.05$), and none of the control variables were statistically significant, indicating that demographic and organizational characteristics had minimal influence on agility.

Model 2 introduced BAC, which showed a strong positive effect on SCA ($\beta = 0.48$, $p < 0.001$), providing support for H1.

Model 3 examined the moderating role of SCD. The interaction term ($BAC \times SCD$) was significant ($\beta = 0.20$, $p < 0.01$), indicating that digitalization strengthens the positive effect of BAC on agility, thereby supporting H4.

Model 4 assessed the moderating role of SCC. The interaction ($BAC \times SCC$) was also positive and significant ($\beta = 0.24$, $p < 0.001$), suggesting that organizations with stronger smart contract capabilities convert analytical insights into agile operations more effectively. Thus, H6 is supported.

Model 5 incorporated both moderators simultaneously. Both interaction effects remained significant ($BAC \times SCD$: $\beta = 0.18$, $p < 0.01$; $BAC \times SCC$: $\beta = 0.22$, $p < 0.001$), and the explanatory power increased substantially ($R^2 = 0.47$), confirming that SCD and SCC jointly reinforce the impact of BAC on agility.

Model 6 examined the direct relationship between BAC and SCP. BAC had a positive but relatively modest direct effect ($\beta = 0.09$, $p < 0.05$), suggesting that analytics alone cannot fully explain performance differences.

Model 7 introduced SCA, which exhibited a strong positive effect on SCP ($\beta = 0.42$, $p < 0.001$), providing strong support for H2.

Model 8 tested the mediating role of SCA. After including SCA, the direct effect of BAC on SCP decreased from $\beta = 0.14$ to $\beta = 0.07$, while SCA remained highly significant ($\beta = 0.40$, $p < 0.001$). Bootstrapping (10,000 resamples) confirmed a significant indirect effect ($\beta = 0.201$, 95% CI [0.128, 0.296]), with VAF = 67.4%, indicating partial mediation and supporting H3.

Model 9 evaluated the moderating role of SCD on the relationship between SCA and SCP. The interaction ($SCA \times SCD$) was significant ($\beta = 0.17$, $p < 0.01$), supporting H5.

Model 10 assessed the moderating effect of SCC. The interaction ($SCA \times SCC$) was positive and highly significant ($\beta = 0.22$, $p < 0.001$), demonstrating that SCC enhances the contribution of agility to SCP and supporting H7.

Model 11 estimated the full research model. The model explained 57% of the variance in SCP ($R^2 = 0.57$), and all proposed relationships remained significant. Overall, the findings

demonstrate that BAC improve performance primarily through SCA, while SCD and SCC strengthen this transformation by enhancing digital integration and execution efficiency.

Summary of Hypothesis Testing

Table 4 summarizes the empirical findings for all proposed hypotheses.

Table 4. Summary of Hypothesis Testing

Hypothesis	Proposed Relationship	Result
H1	BAC $\rightarrow$ SCA	Supported
H2	SCA $\rightarrow$ SCP	Supported
H3	SCA mediates the relationship between BAC and SCP	Supported (Partial Mediation)
H4	SCD positively moderates BAC $\rightarrow$ SCA	Supported
H5	SCD positively moderates SCA $\rightarrow$ SCP	Supported
H6	SCC positively moderates BAC $\rightarrow$ SCA	Supported
H7	SCC positively moderates SCA $\rightarrow$ SCP	Supported

Overall, the empirical findings strongly support the proposed moderated mediation framework. The results indicate that BAC alone are insufficient to maximize organizational performance. Instead, their value is realized primarily through the development of SCA, while complementary capabilities, namely SCD and SCC, significantly strengthen the transformation of analytical intelligence into agile operations and superior SCP. These findings provide robust empirical support for the Dynamic Capabilities View and demonstrate that competitive advantage in financial service supply chains depends on the effective integration of analytical, digital, and execution-oriented organizational capabilities.

Interaction Plots for Moderation Effects

Below are four figures visualizing the moderation effects tested in the regression models. Variables are standardized (mean = 0, SD = 1), and slopes are calculated using coefficients from the hierarchical regression table. High/low moderator values are set at ± 1 SD. Fig. 2 demonstrates that all interaction effects follow the expected positive pattern, providing graphical support for the proposed moderating hypotheses.

As illustrated in Fig. 2, all four interaction plots exhibit positive moderating effects, providing visual support for the proposed hypotheses. The first panel shows that the relationship between BAC and SCA becomes considerably stronger when SCD is high, indicating that digital infrastructure enables organizations to convert analytical insights into agile operational responses more effectively. The second panel demonstrates a similar pattern for SCC, suggesting that intelligent contract execution strengthens the ability of analytics-driven organizations to enhance SCA.

The third interaction plot indicates that SCD amplifies the positive impact of SCA on SCP. Organizations operating within highly digitalized environments are therefore better positioned to transform agile capabilities into superior operational outcomes. Finally, the fourth panel illustrates that SCC also reinforces the agility–performance relationship. Organizations with advanced smart contract capabilities benefit from automated execution, improved coordination, and greater transaction efficiency, allowing agile supply chain practices to generate higher levels of organizational performance. Collectively, these interaction plots visually confirm the complementary roles of SCD and SCC in strengthening both stages of the proposed moderated mediation framework.

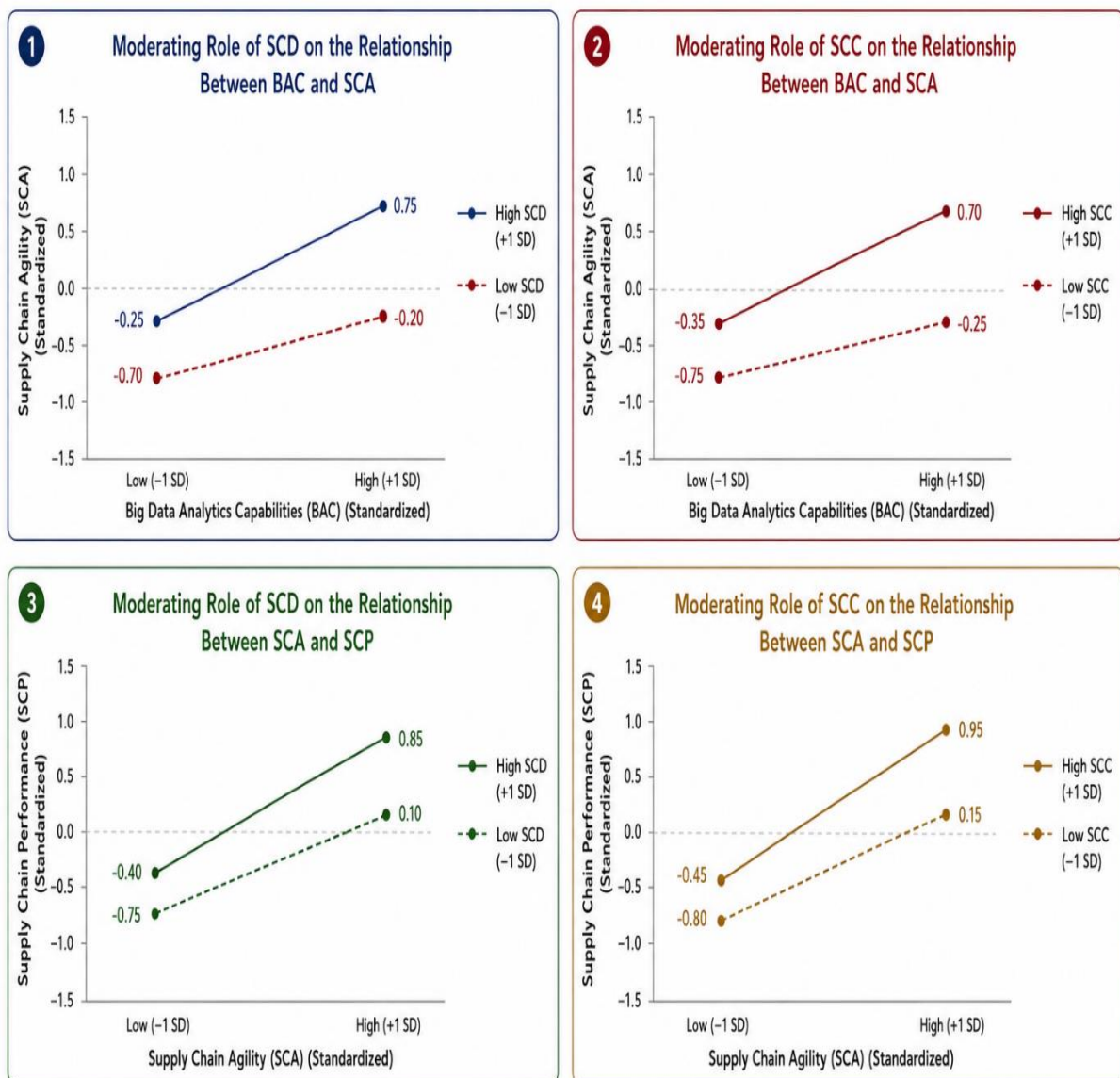


Fig 2. Interaction plots for moderating effects

Discussion of findings

Main Result

The findings provide strong empirical evidence that BAC constitute a fundamental organizational capability for enhancing SCA within financial service supply chains. The significant positive relationship between BAC and SCA indicates that organizations capable of collecting, integrating, and interpreting large volumes of data are better positioned to sense environmental changes, anticipate operational risks, and respond rapidly to evolving customer requirements and regulatory demands. In financial services, where operational continuity, transaction accuracy, and service responsiveness are critical, analytical capabilities enable managers to replace reactive decision-making with proactive and evidence-based actions. This finding reinforces the Dynamic Capabilities perspective by demonstrating that data analytics strengthens an organization's sensing and decision-making capabilities, thereby improving its ability to adapt to rapidly changing business environments.

The results further demonstrate that SCA serves as the primary mechanism through which analytical capabilities improve SCP. Although BAC exerts a direct positive influence on performance, the mediation analysis reveals that a substantial proportion of its impact is transmitted through agility. This finding suggests that analytical intelligence alone does not automatically generate superior organizational outcomes. Instead, firms must possess the capability to rapidly transform analytical insights into coordinated operational actions. In financial service ecosystems, agility enables organizations to accelerate service delivery, improve process reliability, respond effectively to market volatility, and maintain high levels of customer satisfaction despite increasing environmental uncertainty. Consequently, agility represents the critical organizational capability that bridges the gap between data-driven knowledge and measurable operational performance.

An important contribution of this study is the identification of SCD as a complementary capability that strengthens the effectiveness of BAC. The significant moderating effect of SCD indicates that organizations operating within highly digitalized environments derive considerably greater agility benefits from their analytical capabilities than firms with less developed digital infrastructures. Digital integration facilitates real-time information sharing, seamless connectivity among organizational units, and faster execution of operational decisions, allowing analytical insights to be disseminated and implemented more efficiently throughout the supply chain. These findings suggest that investments in analytics generate greater strategic value when supported by integrated digital platforms that improve organizational coordination and responsiveness.

The results also highlight the strategic importance of SCC as an organizational capability that extends beyond the technological foundations of distributed ledger systems. Rather than merely serving as a technological application, SCC enables organizations to automate contractual execution, standardize business processes, reduce transaction delays, and improve coordination across organizational boundaries. The positive moderating effects observed in both stages of the research model indicate that organizations possessing stronger smart contract capabilities are more successful in translating analytical intelligence into agile operations and subsequently converting agility into superior SCP. These findings suggest that intelligent execution capabilities complement analytical capabilities by reducing operational friction and accelerating organizational responses without compromising transparency or compliance.

Taken together, the findings demonstrate that superior SCP in financial services cannot be achieved through isolated technological investments. Instead, organizational success depends on the integration of complementary capabilities that collectively enhance information processing, operational coordination, and execution efficiency. BAC provide the intelligence required for informed decision-making, SCA transforms that intelligence into adaptive organizational responses, while SCD and SCC reinforce both stages of this transformation process. This integrated capability configuration explains why organizations with comparable analytical resources often achieve substantially different performance outcomes and underscores the importance of combining analytical, digital, and execution capabilities to sustain competitive advantage in increasingly digital financial ecosystems.

Theoretical Contributions

This study makes several important contributions to the literature on supply chain management, digital transformation, and dynamic capabilities by explaining how analytical, digital, and execution capabilities jointly improve SCP in financial service organizations. Rather than examining digital technologies in isolation, the proposed framework demonstrates how multiple complementary capabilities interact to transform analytical intelligence into superior operational outcomes.

First, this research extends the Dynamic Capabilities Theory by providing empirical evidence that the value of BAC depends not only on an organization's ability to generate insights but also on its ability to reconfigure operations through SCA. By identifying agility as the principal mediating mechanism, the study clarifies how firms convert data-driven knowledge into measurable performance improvements. These finding advances previous research that primarily focused on the direct relationship between analytics and organizational performance while offering limited explanation of the organizational processes underlying this relationship. Second, this study contributes to the growing literature on SCD by demonstrating that SCD functions as a strategic boundary condition that strengthens the effectiveness of analytical capabilities. Rather than treating digitalization as an independent technological initiative, the findings show that digital infrastructure amplifies the organizational value of analytics by facilitating information integration, collaboration, and coordinated decision execution across supply chain partners.

Third, one of the most significant theoretical contributions is the introduction of SCC as a distinct organizational capability. Previous studies have predominantly examined blockchain technology from the perspectives of transparency, traceability, and information security. In contrast, this research conceptualizes SCC as an organizational competence that enables intelligent execution, workflow automation, and transaction coordination. By positioning SCC as a higher-order capability instead of merely a technological application, the study broadens the theoretical understanding of intelligent automation within digital supply chains and offers a new perspective for future research.

Finally, this study develops and validates an integrated moderated mediation framework that simultaneously incorporates analytical capabilities, organizational agility, digitalization, and SCC. The findings demonstrate that sustainable SCP emerges from the interaction of

complementary organizational capabilities rather than from isolated technological investments. This integrated perspective enriches the literature on digital supply chains by highlighting the synergistic relationships among sensing, adaptation, digital integration, and execution capabilities, thereby providing a more comprehensive explanation of organizational performance in increasingly digital and data-intensive financial service ecosystems.

Practical and Managerial Implications

The findings of this study offer several practical implications for managers and decision-makers seeking to strengthen SCP within financial service organizations. As financial ecosystems become increasingly digital, organizations must move beyond isolated technology adoption and develop complementary capabilities that jointly enhance decision quality, operational responsiveness, and execution efficiency.

First, managers should recognize BAC as a strategic organizational capability rather than merely an investment in analytical software. Financial institutions should establish integrated data governance frameworks, improve data quality, and develop advanced analytical competencies that enable real-time monitoring of customer behavior, transaction flows, operational risks, and regulatory changes. Such investments allow organizations to make faster, evidence-based decisions and proactively respond to dynamic market conditions.

Second, the results demonstrate that analytics alone is insufficient to achieve superior organizational performance. Managers should therefore prioritize the development of SCA by redesigning operational processes to support rapid decision-making, cross-functional collaboration, and flexible resource allocation. Agile organizations are better equipped to respond to unexpected disruptions, changing customer expectations, and evolving regulatory requirements while maintaining service continuity and operational reliability.

Third, the significant moderating effect of SCD suggests that organizations should continue investing in integrated digital infrastructures. Digital platforms that connect internal departments with customers, financial partners, and service providers facilitate real-time information exchange, improve process visibility, and accelerate organizational coordination. Consequently, digitalization enables firms to extract greater value from their analytical capabilities and translate insights into effective operational actions.

A particularly important managerial implication concerns the role of SCC. Rather than viewing smart contracts solely as a blockchain application, managers should develop organizational capabilities for designing, implementing, governing, and continuously improving automated contractual processes. Smart contracts can reduce administrative workload, accelerate transaction execution, minimize operational errors, strengthen compliance, and improve coordination among multiple stakeholders. In financial services, these capabilities are particularly valuable for payment processing, claims management, trade finance, digital lending, regulatory reporting, and other transaction-intensive activities where speed, transparency, and accuracy are essential.

Finally, the findings indicate that competitive advantage is created through the integration of complementary capabilities rather than isolated technological investments. Managers should therefore adopt a holistic digital transformation strategy that simultaneously develops analytical

capabilities, digital infrastructure, organizational agility, and intelligent execution mechanisms. Organizations that successfully combine these capabilities will be better positioned to improve operational efficiency, strengthen customer satisfaction, increase organizational resilience, and sustain superior SCP in increasingly complex and digitally connected financial ecosystems.

Limitations and Future Research

This study has several limitations that provide opportunities for future research. First, the data were collected from financial service organizations operating in Iran, which may limit the generalizability of the findings to other countries with different institutional, technological, and regulatory environments. Future studies could replicate the proposed framework across different national contexts or conduct cross-country comparisons to enhance external validity. Second, the research employed a cross-sectional survey design, which captures organizational capabilities at a single point in time. Longitudinal studies would provide deeper insights into how BAC, SCD, and SCC evolve over time and jointly influence organizational performance during digital transformation.

Finally, although this study focused on SCA as the primary mediating mechanism and examined SCD and SCC as moderators, additional organizational capabilities may further explain the relationship between analytics and performance. Future research could investigate the roles of artificial intelligence capability, organizational resilience, supply chain integration, digital trust, cybersecurity capability, or innovation capability within more comprehensive moderated mediation frameworks. Such extensions would further advance the understanding of capability integration and digital transformation in increasingly complex financial service ecosystems. Future research could also examine the environmental sustainability implications of blockchain-based technologies (Safizadeh, 2024).

Conclusion

This study developed and empirically validated an integrated framework explaining how Big Data Analytics Capabilities (BAC) improve Supply Chain Performance (SCP) through the mediating role of Supply Chain Agility (SCA) while considering the complementary moderating effects of Supply Chain Digitalization (SCD) and Smart Contract Capability (SCC). Using evidence from financial service organizations in Iran, the findings demonstrate that analytical capabilities alone are insufficient to generate superior operational outcomes. Instead, organizations create greater value when analytical insights are transformed into agile organizational responses and supported by complementary digital infrastructure and intelligent execution capabilities. The results confirm that Supply Chain Agility represents the primary mechanism linking analytical capabilities to organizational performance, whereas Supply Chain Digitalization and Smart Contract Capability significantly strengthen both the development of agility and the conversion of agility into superior performance. These findings reinforce the Dynamic Capabilities perspective by illustrating that sustainable competitive advantage arises from the integration of complementary organizational capabilities rather than isolated technological investments. Beyond its empirical findings, this study broadens the digital supply chain literature by conceptualizing Smart Contract Capability as a strategic

organizational capability instead of merely an application of blockchain technology. This perspective shifts attention from technological adoption toward intelligent execution capabilities that improve coordination, automate business processes, and enhance operational efficiency across financial service ecosystems. Overall, this research provides a comprehensive explanation of how analytics, agility, digitalization, and smart contract capability jointly contribute to organizational performance in increasingly digital and data-intensive financial environments. The proposed framework offers valuable guidance for both researchers and practitioners seeking to understand how complementary digital capabilities can be orchestrated to build more agile, resilient, and high-performing financial service supply chains.

Statements and Declarations

Ethics Statement: The author declares that this study was conducted in accordance with established ethical principles and guidelines. All sources of information have been properly cited and acknowledged. Where applicable, ethical approval was obtained, and informed consent was secured from all participants. The research did not involve any form of plagiarism, fabrication, or falsification of data.

Use of Artificial Intelligence: The author acknowledges that AI-based tools were used solely for language editing and grammar checking. All AI-assisted content was carefully reviewed, verified, and edited by the author, who takes full responsibility for the accuracy, originality, and integrity of the final manuscript. AI tools were not used to generate or manipulate research data or to replace critical scholarly judgment.

Originality and Publication: The author declares that this work has not been published previously and is not under consideration for publication elsewhere.

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Compliance with Regulations: The author confirms that the study complied with all applicable institutional, national, and international regulations, and that any necessary permissions for data use and reproduction have been obtained.

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