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Organizational Learning Through Disruptive Digital Innovation. A Blockchain Implementation

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Organizational Learning Through Disruptive Digital Innovation. A Blockchain Implementation

by

Veneetia Smith Johnson

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree

Of

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ACCEPTANCE

This dissertation was prepared under the direction of the *VENEETIA SMITH JOHNSON* Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Business Administration in the J. Mack Robinson College of Business of Georgia State University.

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I once heard that pursuing a doctoral degree is a lonely journey. While there were moments when I felt alone, there was no doubt that I never stood unaccompanied. To my Heavenly Father, I offer my praise and adoration for His unending protection while watching over my family and friends and for His spiritual guidance when my human ability was insufficient.

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LIST OF ABBREVIATIONS

Abbreviations	Definition
API	Application Program Interface
BU	Business Unit
BCA	Blockchain Member Alpha
BCL	Blockchain Member Logistics
BCP	Blockchain Project
BCS	Blockchain Member Supplier
Co-development	Collaborative Development
COMAT	Company Materials
CRM	Customer Relationship Management
DDI	Disruptive Digital Innovation
DTCC	Depository Trust & Clearing Corporation
EDI	Electronic Data Interchange
IoT	Internet of Things
IP	Intellectual property
IT	Information Technology
P2P	Peer-to-Peer
POC	Proof of Concept
PMO	Project Management Office
RFID	Radio Frequency Identification
ROI	Return on Investment
SaaS	Software as a Service
SAFe	Scaled Agile Framework
SCM	Supply Chain Management
SD	System Development
SLG	Senior Leadership Group

ABSTRACT

Organizational Learning Through Disruptive Digital Innovation. A Blockchain Implementation

by

Veneetia Smith Johnson

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Organizational learning and management are at a transition point because of the shift in disruptive digital innovations (DDI). Organizing axioms are challenged or fundamentally changed by the nature of innovation (Nambisan, Lyytinen, Majchrzak, & Song, 2017). There is widespread recognition that investing in organizational learning drives change and innovation (Linares, 2017). The early research examined DDI and the factors that enable or inhibit it. However, there is a limited amount of research on the relationship between DDI and organizational learning. More specifically, research that is conducted to understand the theoretical relationship between organizational learning and DDI is needed. The phenomenon has been studied in the rich context of information technology (IT) and supply chain management (SCM). In this research, a single case study approach is used to examine single- and double-loop learning. IT organizations use DDI to remain practical in a dynamic environment. In the present study, the DDI framework is used to illustrate how organizational learning is facilitated. Recommendations are offered on how IT organizations could enhance organizational learning to improve project implementation and delivery related to disruptive digital innovation.

INDEX WORDS: disruptive digital innovation, organizational learning, blockchain, organizational inertia

I CHAPTER 1: INTRODUCTION

I.1 Research Domain

Organizations strive to develop innovative capabilities that help them achieve a competitive advantage in the marketplace (Wang & Dass, 2017). In 2017, the ability to innovate was listed as a top concern of chief information officers (CIO) (Kappelman et al., 2018). Innovation is the process of successfully creating something new that has a significant value for the relevant unit of adoption (Adner, 2002; Govindarajan & Kopalle, 2006; Hwang, 2008). Innovation is necessary for survival in dynamic markets that are characterized by economic uncertainty (Hwang, 2008). The development of distinct capabilities in periods of disruptive digital innovation (DDI) (Alqudah & Razali, 2016) is increasingly becoming an integral part of an organization's competency. The supply chain industry is rapidly experiencing this phenomenon because of the introduction of the distributed technology ledger, blockchain. While many industries have dramatically transformed through leveraging DDI, recent research has suggested that the factors that enable organizations to successfully adopt such innovations require further research (Svahn, Mathiassen, & Lindgren, 2017b; Christensen, 2003). According to Orlikowski (2001), organizations are faced with technical disruptions that alter the way work is achieved. Therefore, the research in this area must be extended to understand how organizations should respond to disruptions caused by technology.

By providing leaders with the ability to combine technological advances with appropriately matched business models, DDI can bring affordability to the market (Markides, 2006; Marnix, 2006). How can organizations manage DDI? Although previous studies offered insights into how organizational structures enable DDI, further research is required to examine how managers trigger changes that are essential to successfully embracing DDI (Justin, Frans, &

Henk, 2006). Furthermore, little is known about how to help managers embrace and implement DDI in their organizations (Dan & Chang, 2010). The ability to deploy disruptive technologies is a strategic driver of the success of many organizations. Because of the rapidly growing role of the technology-enabled disruptions that are transforming industries, there is a need to better understand how organizations can innovate successfully through such disruptions (Clayton, Christensen, Raynor, & McDonald, 2015).

Successful DDIs, at their core, demand active attention to organizational learning (Sherif, Zmud, & Browne, 2006). It is well established that organizational learning is essential to an organization's ability to innovate (Bell, Whitwell, & Lukas, 2002 March, 1991). Organizational learning is defined as the process of improving actions through better knowledge and understanding (Fiol & Lyles, 1985). Organizations must continually depend on this ability to adapt more rapidly to remain competitive (Argyris & Schön, 1997).

I.2 Research Perspective

There is increased interest in studying organizational learning in IT because of the rate of change in the industry and the financial investments needed to support learning. Recent research has suggested that in some companies, learning and development budgets exceed USD $500 million, and they may be as much as USD $1B (McCrea, 2009). Investing in the learning process results in successful innovative efforts within the organization (Nouri, Ghorbani, & Soltani, 2017). The value of organizational learning practices resulting from DDI cannot be underestimated (Sherif et al., 2006).

DDI is driven by the latest wave of technological advances in artificial intelligence, data analytics, robotics, the Internet of Things (Kshetri, 2018), and new software-enabled industrial platforms, such as blockchain-based technologies. PricewaterhouseCoopers' (PWCHK.com) worldwide research and development study, Global Innovation 1000, indicated that spending has steadily increased in recent years, reaching USD $760B in 2018. Blockchain is regarded as one of the most innovative technologies developed in recent years (Swan, 2015). Blockchain technology has been applied to a limited extent outside the finance domain. Nevertheless, the arrival of blockchain innovation has the potential to transform critical organizational activities such as SCM. Blockchain is used to effectively measure the performance and outcomes of key supply chain processes (Kshetri, 2018). Hence, there is increasing interest in examining how organizations respond to blockchain technology as a DDI.

I.3 Research Question

Organizations must cultivate a vigilant learning environment to gain the ability to learn quickly and remain competitive (Argyris & Schön, 1997). In previous research, it was concluded that studies were required to determine how DDI implicate organizational learning. Because the relationship between DDI and organizational learning has not been well researched, the aim of this study is to determine how DDI in IT organizations helps such organizations learn.

This study is conducted in the context of the implementation of a specific disruptive technology, namely blockchain technology. The objective of this study is to offer insights into practices that are focused on revealing empirical patterns and developing intellectual tools for understanding and managing the competing concerns that incumbent firms face as they embrace DDI (Svahn, Mathiassen, & Lindgren, 2017a). Specifically, this study will endeavor to answer the following research question: How does managing disruptive digital innovation implicate organizational learning?

Because DDI often involves significant changes to organizational processes and norms, this study examines double-loop learning, which was proposed by Argyris (1976) in his seminal work in the context of a technology organization. The study will examine the shift from single- to double-loop learning by examining DDI as an intervention that may impact learning. This study will reveal the limitations of single-loop learning and the ways in which interventions or processes that lead to organizational learning could facilitate the transition to a double-loop learning organization. This study contributes to the literature by demonstrating the need for double-loop learning in the context of DDI as a learning intervention mechanism. This study also demonstrates how double-loop learning can add value to a technology organization.

I.4 Research Approach

To investigate the role of DDI within a mature IT organization and to understand how DDI contributes to the organization's ability to learn, a qualitative case study design was selected. There is significant academic precedence for using a case study approach to examine information systems to develop deep insights into emerging phenomena (Adner, 2002; Lee, A.S. 1989).

This research methodology was selected because it has been proven effective in researching complex social phenomena, including life cycles, organizational group behavior, and managerial processes (Yin, 2009). The unfettered access that the researcher has in studying a contemporary event in an organization satisfies the conditions for the use of a case study approach, which were outlined by Yin (2009): a) the "how" research question is posed; b) the study is framed in contemporary real-world events; c) in which there is no control. Case studies are ideally suited to example complex changes such as the disruptive changes caused by digital innovations (Besson & Rowe, 2012). Hence, the case study is an ideal methodology for studying the phenomenon of disruption facilitated by IT (Besson & Rowe, 2012).

Based on a single case study approach, the research will draw from the literature on organizational learning and DDI as well as the engaged scholarship model. The engaged scholarship model offers rich insights into the design, data collection, and analysis of the cases under examination (Van de Ven, 2007). As an example of engaged scholarship, this study will be conducted as participative research in which guidance is obtained from the primary stakeholders.

The embedded case study design reflects the intentional strategy of using replication logic to reveal the events that affect the occurrence and effectiveness of the contributions originating in the IT development team (Yin, 2009). The case study method creates the opportunity to record the complexity and dynamic nature of the context within which the events occur (Van de Ven, 2007). The continuous access of the researcher to the setting and participants provide extensive data on key events. In this study, project event sequences formed the foundation of the process model for double-loop learning. Accordingly, the contributions shown in Table 1 reflect the research design and the engaged scholarship framing components in this study (Baird, Davidson, & Mathiassen, 2017). The summary of the research design presents the area of concern, problem setting, theoretical framing, and research method, and it defines the expected contributions made by answering the research question.

Table 1. Research Design Summary

Research Design Summary	
Engaged Scholarship Component	**Research Component**
Area of concern (A)	Disruptive digital innovation in an informational technology (IT) organization
Problem setting (P)	Understanding how managing disruptive digital innovation implicates an organization's ability to learn
Theoretical framing (F) 1. FI: Theory independent of area of concern 2. FI: Theory independent of area of concern	 Organizational learning Disruptive digital innovation theory
Research Method (M)	Qualitative Exploratory Case Study
Contributions (C) 1. To theory (CF) 2. To area of concern (CA) 3. To practice (CP)	 1. CF: Extending and combining models 2. CA: Empirical and theoretical contributions to organizational learning facilitated by IT-enabled disruptive digital innovations 3. CP: Organizational learning barriers and facilitators
Research Question (RQ)	How does managing disruptive digital innovations implicate organizational learning?
Adapted from (Mathiassen, 2017)	

I.5 Organization of the Study

Chapter I presents the introduction, the area of concern, the motivation for the study, the framework, and the research question. Chapter II is a review of the literature related to theoretical and empirical contributions to organizational learning with a focus on double-loop learning. Chapter II also lays the foundation for the research on the process by which organizational learning helps an IT organization manage DDI. Chapter III discusses organizational learning, DDI, the impact in IT organizations, and the need for organizational learning in IT. Chapter IV describes the research setting, design, and methods. This chapter also provides the approach to the data collection and analysis as well as the strategies used to increase the legitimacy of the study. Chapter IV explains the application of engaged scholarship. Chapter V provides an account of the process used to manage DDI, namely blockchain. The process flow, including key events and sequences, is also provided to further strengthen confidence in organizational learning research. Lastly, Chapter VI discusses the study's contributions to theory, the area of concern and practice, and the limitations of the study before recommending directions for future research.

II CHAPTER II – LITERATURE REVIEW

The relevance of organizational learning and management innovation was studied by Swanson (2004), who argued that the effective management of innovation was essential to achieve organizational success. In addition, organizational learning and technical innovation are distinct disciplines that, respectively, are dedicated to studying the social and technical aspects of an organization. Collaboration in studying organizational learning and technical innovation is necessary to understand how organizations should respond to disruption (Orlikowski & Barley, 2001).

II.1 Managing Information Technology

IT management in large organizations often involves sophisticated technical and managerial capabilities, multimillion-dollar budgets, and strategic and operational implications (Masli et al., 2016). Managers face complex challenges, including responding to dynamic environments, designing performance measures that reflect time-to-market pressures, synchronizing and stabilizing development, and improving software processes (Napier, Mathiassen, & Robey, 2011). One of the core competencies of IS and IT managers is the mastery of development relationships with external development partners (Heiskanen, Newman, & Eklin, 2008).

Managerial responsibilities are formalized by the organization’s hierarchical structure (Jay, 1973). Many organizations have chosen to delegate IT management responsibility to a subordinate specialist (Masli et al., 2016). This delegation is a result of technical sophistication and the executive’s attention deficits (Davenport & Beck, 2001). The high technical aptitude of the managing executive increases the mutual trust that exists between the team and the manager, which results in the high likelihood that the organization will be successful in applying technology (Masli et al., 2016).

When an organization lacks specificity regarding the role of IT management, combined with the pervasiveness of technology in business today, significant managerial challenges occur. The ability of an organization to last for decades or even a century while other highly successful and established incumbents either self-destruct or decline into oblivion is primarily based on visionary leadership and management (Tellis, 2006).

II.2 Role of Information Technology Management

The three main roles of IT management are as follows: ensuring operational reliability for the organization, creating and managing new demand, and making decisions that adhere to the strategic direction of the company (Table 2). IT management is responsible for creating the vision and providing the leadership required to achieve an innovative strategic vision (Gharajedaghi, 2011). The IT manager ensures operational reliability by establishing enterprise-wide IT policies and maintaining the stability of the enterprise's digital platform. Information system management (ISM) also requires a wide-ranging vision, as the role requires the ability to use existing knowledge across multiple business domains and contexts (Gharajedaghi, 2011). The successes and failures of each technology effort are directly associated with a manager's ability to respond to emerging competitive and dynamic challenges. One of the reasons that managing software development is challenging is that it requires a high level of coordination (Kudaravalli, Faraj, & Johnson, 2017). Hence, there is a need to research the role of the IT manager in an organization that includes digital innovation (Lyytinen & Rose, 2003). Moreover, IT managers must learn new skills that profoundly challenge existing organizational processes (Jarvenpaa & Ives, 1996).

Research in the IS field has examined more than the technological system. It has emphasized the need to investigate phenomena that emerge when the social system and technology interact (Gregor, 2006).

Table 2. Role of IT Management

Role of IT Management		
Area of Decision Making	Responsibility	Illustrative Decision
Operational Reliability	• Provisioning, operating and maintaining enterprise digital platform • Establishing enterprise-wide IT policies	How should IT-related business risks be assessed, monitored, and mitigated?
Creating New Demand	Stimulating and prioritizing demands for IT-enabled business solutions	How should IT-enabled business initiatives be prioritized?
Strategic Innovation	IT strategies to set the strategic tone for IT investment	What should the dominant strategic role of IT be? How should business cases for digital innovations for business initiatives be selected?

II.3 Managing Information System Innovation

The implementation of blockchain technology requires significant process changes and a high amount of effort. Leaders must examine the organization’s external and internal factors (Hitt & Tyler, 1991). Managers within organizations are faced with intense demands to innovate in the face of internal pressures caused by organizational inertia (Nijssen, Hillebrand, Vermeulen, & Kemp, 2006). Internal factors include the ability of the organization to support a disruptive innovation, such as blockchain technology, whereas external factors include the organization’s environment and conditions. The success or failure of managing disruptive innovation is the result of the internal cultural aspects of the organization, which are tightly integrated with its management (Tellis, 2006). It is imperative to understand how to effectively manage innovation processes in an organization’s context to ensure its success. The unpredictability of managing DDI is the primary reason that innovation management appears to be incoherent and difficult to translate into clear prescriptions (Johannessen & Aasen, 2009). In order to successfully integrate IS in organizational contexts, managers need to understand that practitioners must revise work practices in ways that enhance the outcomes of all elements of the organization (Baird et al., 2017). When DDI is introduced in a competitive environment, the predictability of managerial practices increases the vulnerability of the organization, and its ability to thrive (Liao, Fei, & Liu, 2008). It is widely accepted that an organization must continuously innovate to develop new capabilities without jeopardizing existing processes and production (Svahn et al., 2017a). However, organizational structure and management can prevent innovation from causing frustration in the effort to transform the organization (Gharajedaghi, 2011).

Organizations are not passive pawns controlled by the demands of their environments but active players that respond strategically and innovatively to organizational influences (Orlikowski & Barley, 2001). Therefore, managerial actions can be a central influence on organizational learning; moreover, organizational influences can enable and constrain actions such as learning. One of the challenges of innovation management is to create an environment of perpetual innovation where everyone is committed to excellence, which results in growth and sustained competitive advantage within limits that are aligned with the organization’s strategic initiatives (Johannessen & Aasen, 2009). In addition, as Miller and Lin (2015) stated, complex organizational decisions are often overly simplified to resemble previous experiences.

Based on Pinfield’s (1986) view of decision making, there are two processes by which organizations can reach a decision: structured and anarchic. The structured process is iterative because the issue moves through several stages from problem recognition to problem resolution (Pinfield, 1986). The anarchic process is less organized and more unpredictable than the structured process. The factor that distinguishes the structured process from the anarchic process concerns whether there is an alignment between the organizational vision and the goals of decision making. The anarchic view is deployed when there is disagreement about the organization's objectives. The organization implements differentiation strategies, which allows them to reach better decisions. Management's decision to invest in an emerging technology, such as blockchain, must be aligned with the organization's vision.

II.4 Organizational Learning in Managing Information Technology

IT organizations invest in capital resources to create a strategic competitive advantage (Alavi & Leidner, 2001; Pavlou & Sawy, 2006; Sambamurthy, Bharadwaj, & Grover, 2003). Consistent with the notion that organizational learning leads to increased strategic business performance (Fiol & Lyles, 1985), the impact of organizational learning on IT-enabled strategic business performance is significant. Organizations need to develop learning capabilities that go beyond implementing processes that are sufficient to facilitate organizational strategies (Zollo & Winter, 2002). In addition, organizations must be able to respond to rapidly changing business environments. This is especially true for IT organizations. Because of the rapid rate of change in technology, organizations in the IT sector confront significant volatility. IT organizations face volatility caused by start-up IT companies, access to open source technology tools, sustainability, expansion of new technology, and difficulty in converting innovative ideas into practical results. These challenges are heightened in the case of IT organizations that focus on DDI. There is tremendous pressure to focus on technology projects that immediately demonstrate capital profitability in order to continue securing funding for future innovation projects. IT organizations focusing on DDI must also provide evidence of their internal monitoring, such as the project management office (PMO), to ensure that business partnerships with external organizations are not negatively disrupted as a result of the innovation.

When technological and competitive conditions are subject to rapid change, it quickly becomes hazardous to forgo learning and to persist in the same operating routines (Zollo & Winter, 2002). To respond to these factors, organizations must leverage their ability to learn (Iyengar, Sweeney, & Montealegre, 2015). The ability of an organization to transfer knowledge across varying technological contexts requires multiple sources of learning (Gharajedaghi, 2011). The aforementioned concerns demand that technology organizations acquire the competency to learn more effectively so they can successfully deal with the velocity of change required to remain competitive in the market. There may be a uniquely positive benefit to incorporating double-loop learning within technology organizations. However, double-loop learning requires that organizations continuously challenge and evaluate their assumptions and values (Argyris, 1976).

III CHAPTER III – THEORETICAL FRAMEWORK

Scholarly consensus regarding the definition of learning is rare, particularly across disciplines, such as education, linguistics, and business (Dodgson, 1993). A theorist in experiential learning, Kolb (2014) stated that learning is a process in which knowledge is created through experience. Argyris and Schön (1978) stated that learning happens when new knowledge is translated into behaviors that are capable of being replicated. Kim (1998) deemed learning as increasing the capacity of a person or an organization to take effective action. Individuals are born with the innate capability to learn and adapt to disruption and innovation in evolving environments (Liao et al., 2008).

Learning has two meanings: 1) the acquisition of a skill or know-how, which implies the physical ability to produce some action; 2) the acquisition of know-why, which implies the ability to articulate a conceptual understanding of experience (Kim, 1997). A competitive advantage is gained by shifting away from access to information to purposefully generate knowledge through the process of learning and unlearning (Gharajedaghi, 2011).

III.1 Managing Innovation in Supply Chain Management

To make the best decisions, managers require access to real-time data on their supply chain; however, the limitations of legacy technologies hinder end-to-end transparency (Lyall, Mercier, & Gstettner, 2018). New digital technologies, such as blockchain, have the potential to disrupt traditional SCM and how organizations collaborate (Hanifan & Timmermans, 2018).

First applied in the financial industry, blockchain is a transaction technology that provides a system for mediating trust and selective transparency. Investors in the stock market rely heavily on the Depository Trust & Clearing Corporation (DTCC) to settle transactions because organizations do not share their internal databases (Andreessen, 2014). Moreover, intermediaries such as DTCC take up to three business days to settle transactions (Prisco, 2016). The clearing process requires time and labor, resulting in fees that the consumer must pay to access the information (Primm, 2016).

In contrast, blockchain provides a central access to information in real time, eliminating the need for costly, time-consuming intermediaries to confirm transactions (Andreessen, 2014). The information is constantly replicated and disseminated to all members of the network, and cryptography prevents retroactive modifications to the transactions (Primm, 2016). Similar to financial decision management, the supply chain industry uses blockchain to transfer titles, record permissions, and distribute activity logs that track the flow of goods and services between organizations without the need for costly intermediaries (Casey & Wong, 2017).

III.2 Organizational Learning

Organizational learning refers to the ways in which organizations build knowledge, create routines within their cultures, and develop organizational efficiency by improving the use of their workforces. In the academic literature, there is widespread acceptance of the importance of organizational learning (Fiol & Lyles, 1985).

As shown in Table 3, there are multiple components of organizational learning. Stata and Almond (1989) suggested that an organization's ability to learn is the only competitive advantage for sustainable and long-lasting growth. Organizational learning is vital to an organization's ability to respond to innovation and continuous change (Flores, Zheng, Rau, & Thomas, 2012). Furthermore, the ability of an organization to act is dependent on its ability to learn (Slater & Narver, 2009).

Table 3. Definitions of Organizational Learning

Definitions of Organizational Learning		
Article	Framework	
Argyris, 2002	Double-loop Learning	Double-loop learning occurs when errors are corrected by changing the governing values and then the actions. The question of “why” is activated.
Daft & Weick, 1984	Organizational Memory	Organizational learning allows organizational knowledge to be preserved through membership changes.
Fiol & Lyles, 1985	Organizational Learning & Adaptation	Organizations develop and maintain learning systems that influence current and future members.
March, 1991	Exploration and Exploitation	Theories of organizational action; Assimilation to organizational goals and rules

Although it is common for organizations to have a set of goals, values, and objectives, they rarely question or evaluate their continual effectiveness. This approach is referred to as single-loop learning. Figure 1 demonstrates the inner loop that represents single-loop learning, which is an adaptive learning process.

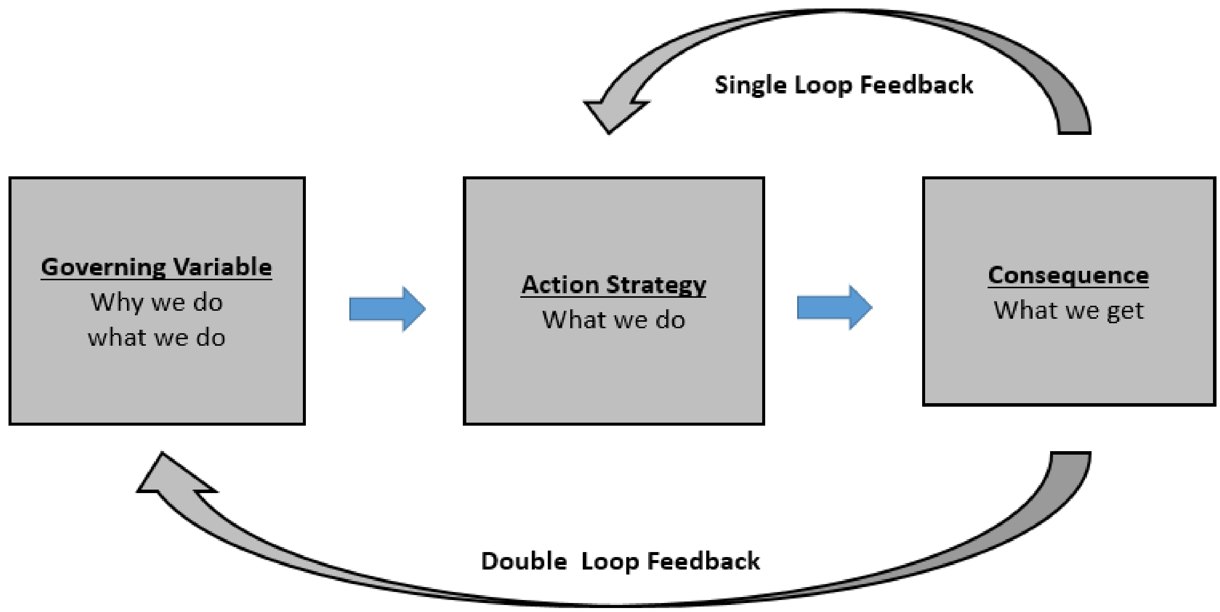


Figure 1. Double-loop learning (Argyris, 1976)

Organizations learn through their individual members being directly or indirectly affected by individual learning (Kim, 1997). However, organizational learning is not the summation of each member's individual learning (Fiol & Lyles, 1985; Dodgson, 1993). Organizations learn from experience either through trial-and-error experimentation or organizational research (Levitt & March, 1988). The learning process is fundamentally distinct from individual learning. Liao et al. (2008) suggested that organizational learning occurs when the organization's members use learning to solve a shared problem.

For any organization to be successful and thrive, exploration and exploitation must be deployed and balanced over time. Studies have shown that an organizational environment that emphasizes both incremental exploratory learning and disruptive exploitative learning are more successful (Bierly & Chakrabarti, 1996). Levinthal and March (1993) defined exploration as "the pursuit of knowledge, of things that might come to be known," and exploitation as "the use and development of things already known" (p. 105). Exploration includes flexibility, discovery, and innovation, whereas exploitation includes production, efficiency, implementation, and execution. However, pursuing exploration and exploitation simultaneously may be challenging for organizations. For example, it was found that the exploration of new alternatives reduced the speed with which existing skills were improved (March, 1991). The differences between exploitation and exploration include strategic intention, process, and levels of commitment and return. Moreover, exploitation requires convergent thinking to reduce variability, increase efficiency, and achieve continuous improvement along existing technological trajectories (Jin, Zhou, & Wang, 2016).

Exclusive engagement in exploration leads to neglecting the development of ideas, which does not benefit the organization. However, exclusive engagement in exploitation may lead to entrapment in the status quo (March, 1991). Finding the appropriate balance is key to both survival and prosperity (March, 1991; Volberda & Lewin, 2003).

Management studies have highlighted the importance of an organization's capability both to exploit existing knowledge and technologies for short-term profit and to explore new knowledge and technologies to enhance long-term innovation (Eriksson, 2013). In his foundational work, March (1991) linked innovation and knowledge management to explicate the tensions surrounding exploitation and exploration (Constantine & Marianne, 2009; March, 1991). In their study, Constantine and Marianne (2009) observed that the complexity of the tensions intensified management challenges. Because organizational resources are often limited, March (1991) concluded that explicit and implicit choices are made in pursuit of exploration and exploitation. Explicit choices are defined as decisions regarding investing and strategic decisions. Implicit choices are embedded in an organization's culture, processes, and procedures.

The existing literature is replete with warnings about the difficulties in managing exploitation–exploration tension (Constantine & Marianne, 2009). There is still a limited understanding of how exploration and exploitation could be facilitated in inter-organizational relationships through different organizational designs and contractual arrangements (Eriksson, 2013). Mature IT organizations often establish separate business units in responding to DDI. This type of organizational environment protects its traditional business units. However, more effective leadership by management is needed to create organizational integration.

Consistent with the existing literature, five sub-processes comprise the learning cycle: information acquisition, information distribution, information interpretation, knowledge integration, and organizational memory (Flores et al., 2012). The process of collecting information originates in organizational learning. The subsequent process requires disseminating the acquired information throughout the organization. The subsequent steps of interpretation and integration can be cyclical. In concluding the learning process, information is institutionalized because it is stored in the organizational memory (Flores et al., 2012).

III.3 Single and Double Loop Learning

Argyris and Schön (1997) described loop learning as a means of demonstrating how organizational members, acting as agents for organizational inquiry, assist in organizational learning. In the literature, exploitative learning is described as a ‘‘single-loop’’ (Argyris, 1976). In single-loop learning, the organization’s design and goals are not disrupted (Argyris, 1976). Understanding the concept of single-loop learning is essential for appreciating double-loop learning. In single-loop learning, the first critical element is the transformation of information needs into well-defined questions. Organizational learning is effective when it is supplemented by the best evidence on which to base the answers to questions. The second element involves researching the data and finding evidence that is required to answer questions. In the final stage, the data are critically evaluated for validity and applicability.

As shown in Figure 1, double- and single-loop learning are complementary, which allows for errors to be identified, corrected, and leveraged. According to Jaaron et al. (2017), in single-loop learning, a behavior is changed as the result of errors, but the values and norms underlying the behavior remain the same (Jaaron & Backhouse, 2017). Single-loop learning is invoked when organizational objectives are operationalized. The transition to double-loop learning begins when the organizational objectives are proactively questioned and then revisited to determine their continued effectiveness. When it is determined that there is a failure in action strategies, in double-loop learning, the governing elements are re-examined. If new governing elements are adopted in the organization, the final step requires teaching the new governing elements and processes.

Double-loop learning is a key element of successful outcomes in organizations (Argyris & Schön, 1997). Argyris (1976) developed the double-loop learning model by adding a secondary loop to the single-loop learning model. The significant difference between double-loop learning and single-loop learning is the connection between errors and the organization's values, norms, strategies, and assumptions (Argyris & Schön, 1996). A critical component of double-loop learning is the review of outcome performance and the impacts of organizational goals. When the outcomes are misaligned with the action strategy, the leadership must take corrective action to increase the effectiveness of organizational performance.

According to Argyris (2002), single-loop learning occurs when corrections to problems are implemented without regard for or changes to the governing values. Unlike single-loop learning, double-loop learning is focused on solving complex and ill-structured problems.

Alternatively, double-loop learning occurs when changes to the governing values cause corrective actions to ensure that the organization understands that the governing variables within it affect its action strategy. The action strategy includes the organizational goals, values, and techniques that are considered necessary to achieve the desired organizational outcomes.

Double-loop learning helps organizations understand how to solve complex and ill-structured problems in a rapidly changing environment (Argyris & Schön, 1974). Double-loop learning comprises three elements: the governing variables are the dimensions that people try to keep within acceptable limits; the action strategies are the moves and plans used by people to keep their governing variables within the acceptable range; the consequences are the results of an action (Cao, Mohan, Ramesh, & Sarkar, 2013) The governing variables are implemented by action strategies, which results in consequences (Argyris, 2002). The relationship between single-loop learning and double-loop learning is shown in Figure 1.

In double-loop learning, activities that strengthen the status quo are unlearned and replaced by new references and new interpretive programs that are deployed in the organization (Fiol & Lyles, 1985). Consequently, learning that goes beyond increasing quantitative efficiencies in existing cyclical routines becomes instrumental in innovation (Argyris & Schön, 1997; Zollo & Winter, 2002). Single-loop learning enables small quantitative increases in innovation. A DDI, such as blockchain, introduces qualitative innovation. Researchers have argued that qualitative innovation can only be achieved by double-loop learning (Stata & Almond, 1989).

The conceptualization of Argyris and Schön’s (1978) single- and double-loop learning can be realized across diverse industry settings. For example, double-loop learning has been applied in the healthcare industry. The application of smartphones and tablets continues to disrupt the traditional flow of communications in various fields, such as the healthcare industry where it has altered information delivery and patient experience. In 2016, research showed that access to smartphones or tablets during patient–doctor encounters resulted in patients experiencing double-loop learning and increased patient satisfaction (Reychav, Kumi, Sabherwal, & Azuri, 2016).

III.4 Rarity of Double Loop Learning

Explanations in the existing literature provide multiple reasons that double-loop learning is rarely achieved. Some researchers have argued that double-loop learning is rarely achieved because of the lack of scholarly consensus on what this form of learning constitutes (Jaaron & Backhouse, 2017). Moreover, the lack of a distinction between single- and double-loop learning has led to a lack of empirical research on double-loop learning (Visser, 2007).

According to a second explanation in the literature, double-loop learning is rarely practiced because of individual and organizational cultures. Previous research suggested that individuals are acculturated to be single-loop learners (Argyris & Schön, 1974). Organizationally, double-loop learning challenges managerial leadership because the detection and correction of inefficient processes could involve the modification of underlying norms as well as the policies and objectives of the leader (Coleman, 1978). Furthermore, employees who apply double-loop learning risk challenging their manager’s long-held norms, policies, and objectives (Argyris & Schön, 1974). Hence, to overcome the organizational culture, the managerial leader must be skilled in eliciting double-loop learning (Argyris, 1976).

A third explanation in the literature refers to generically termed “anti-learning” patterns because of their common occurrence (Argyris, 2002). Anti-learning occurs when individuals attempt to solve a problem that potentially or actually threatens their sense of competency to solve such problems (Argyris, C. 1996). Double-loop learning requires an individual to question personal norms and governing values. When there is a need to question personal norms and governing values, internal conflict may arise, resulting in the employee's deployment of anti-learning strategies for his or her self-preservation. Hence, anti-learning strategies are characterized as defensive and self-fulfilling (Argyris, 2002).

III.5 Facilitators and Barriers to Learning

To facilitate organizational learning, the barriers that prevent an organization from achieving single- or double-loop learning need to be eliminated. Eliminating barriers to learning is of particular relevance when large-scale organizational changes are implemented, such as to the SCM system (Schimmel, 2009). According to Schilling (2009), learning is impeded when the learning cycle is interrupted. According to the current literature, there are three major barriers that interrupt learning cycles: 1) environmental instability; 2) organizational structure; 3) individual learning.

The first barrier to organizational learning is environmental instability. The stability of the organization's environment is an important aspect of organizational learning (Fiol & Lyles 1985). Environmental instability occurs when organizational processes are not given the opportunity to become norms because subsequent changes occur too rapidly (Zell, 2001). Environmental instability can also be the result of external organizational environmental factors, such as a drastic change in market prices (Duncan, 1972).

The second barrier to organizational learning is organizational structure. The organizational structure should create work conditions to allow organizational changes. According to Schilling (2009), organizational structural factors, such as politics, can also create a barrier to organizational learning by constricting the leader's decision making. The organizational structure should also create the opportunity for error correction to occur when errors are identified in facilitating learning (Schilling, 2000). When errors are detected, the organization should be granted the opportunity to correct the error before it becomes an organizational norm (Argyris, C. 2002). Organizational norms may also hinder the transfer of knowledge within the team, further impeding organizational learning.

The third barrier to organizational learning is individual learning accountability. The individual's ability to evaluate the cognitive norms and processes that guide organizational behavior is essential for learning (Argyris, 2002). The absence of an evaluation process to validate organizational processes is also a barrier to learning. Organizational learning is dependent on error detection as an outcome of the organizational evaluation that leads to the action strategies that are to be adjusted (March, 1991). Leaders are expected to play an active role in providing actionable feedback for employees to ensure learning (London, 2004).

While organizational inertia creates barriers to organizational learning, exploring innovation, and disruptive ideas facilitates organizational learning (Elliott & Goh, 2013). Previous studies have also identified leadership as a major facilitator of organizational learning. Recent studies have reported that leadership is the most pervasive factor in facilitating organizational learning (Elliott & Goh, 2013). Similarly, Preskill and Torres' (1999) findings indicated that the role of leadership is foundational in facilitating organizational learning. Establishing an organizational learning culture is led by senior leadership. The organizational learning culture embeds the expectation of promoting teamwork (Trim & Upton, 2013). According to Ellinger and Bostrom (2002), most managers fail to see themselves as facilitators of learning; nor do they realize that they lack the skills to help facilitate organizational learning.

Orlikowski (2001) added that organizational context is one of the most critical facilitators that affect organizational learning (Orlikowski & Barley, 2001). The organizational context includes organizational policies, strategies, and structure. Ellinger et al. (2002) concurred that organizational policies, strategies, and structures are important but pointed out that the impact would be reduced if the motivation to learn were not communicated by the highest leadership levels within the organization. Empirical research has shown that contextual factors, such as culture, facilitate organizational learning (Fiol and Lyles, 1985). Openness to participative decision-making and organizational support are cultural factors that facilitate organizational learning (Hurley & Hult, 1998). The environmental factors that influence the organization's access to resources and opportunities also facilitate organizational learning (Bapuji & Crossan, 2004). Such environments also create the perception of psychological safety for the free exchange of new ideas that facilitate learning within the organization (Argyris & Schön, 1978).

In the existing literature, there is inconclusive evidence regarding whether initiatives aimed at enhancing organizational learning fail because of ignorance of the barriers to and facilitators of organizational learning (Schimmel, 2009).

III.6 Organizational Inertia

Organizations that develop structures and strategies to enhance organizational learning are termed learning organizations (Dodgson, 1993). Such organizations continuously undergo an organizational transformation. Because our research investigates the role of organizational learning in achieving the organizational transformation that is often associated with the introduction of disruptive technologies (e.g. blockchain), we review the literature on the barriers to organizational transformation. (Besson & Rowe, 2012) suggested that organizational transformation requires overcoming organizational inertia so that the organization is in alignment with the environment. Technology is embedded in psychological, economic, socio-cognitive, socio-technical, and political networks, consequently shaping an organization's ability to learn and respond to disruptive technical changes (Orlikowski & Barley, 2001). It is important to understand the relationship between organizational learning and organizational inertia. Organizational learning is often hindered by the impact of organizational inertia on the organization's ability to take advantage of technological innovation. When the capacity to learn becomes rigid because of inertia, the organization needs to realize this shortcoming and then take action to overcome it (Amiripour, Dossey, & Shahvarani, 2017). The ability to overcome organizational inertia is affected by the extent to which the organization is motivated to learn (Seddon, 2010). Organizational inertia has significant theoretical and practical implications for embracing innovation (Besson & Rowe, 2012). Organizational inertia is characterized by the degree of stickiness that must be overcome, and it defines the effort required to propel technology-inspired organizational learning (Besson & Rowe, 2012). The effects of organizational inertia can vary, including the inability for an organization to learn and account for inefficiencies in decision making (Amiripour et al., 2017).

Organizational inertia is a multidimensional concept consisting of five foundational dimensions: psychological, economic, socio-cognitive, socio-technical, and political (Besson & Rowe, 2012). Existing political norms, economic constraints, and psychological frames frequently constrain an organization's response to external change, such as technological innovation, which leads to organizational inertia (Mary, 2009).

Psychological inertia refers to difficulties in changing intellectual structures, awareness, and interpretation (Godkin & Allcorn, 2019), which can be reflected in the organizational norms and values demonstrated at the individual level and the organizational level. According to Besson and Rowe (2012), psychological inertia is a significant dimension at both individual and group levels.

Economic inertia represents the amount of required financial and human capital investments, the organizing conditions of the value chain, and the treatment of sunk costs (Besson & Rowe, 2012). Organizations have multiple priorities that compete for limited resources. Economic inertia can also refer to forces that perpetuate funding to existing priorities, leaving few or no resources for innovation.

Political inertia concerns the organizational structures and power relationships that create forces that prevent organizations from innovating or changing. Organizations are faced with intense demands to innovate in the face of internal pressures caused by organizational inertia (Nijssen et al., 2006). Organizations are embedded in networks of vested interests that have their own dynamics as a result of alliances and partnerships that are built over time (Denis, Lamothe, & Langley, 2001).

Socio-cognitive inertia and social-technical inertia have been observed and analyzed less often than the other dimensions have (Besson & Rowe, 2012). Socio-cognitive inertia refers to the social norms applied to an individual or group, and socio-technical inertia refers to the social norms of technical systems.

III.7 Disruptive Digital Innovation

DDI theory includes a process that is applied in practice. The implicit expectation is that the method will be better than the alternative (Cushing, 1990). DDI originated in IT, and it has had a pervasive and radical impact on development processes and solution deliveries (Lui, Ngai, & Lo, 2016). Disruptive innovations are often the result of a new architecture that deviates from an existing architecture or product line and improves the performance trajectory. The architecture of the product or system orchestrates how the components work together (Henderson & Clark, 1990).

There are two conditions for DDIs. IT innovation must be pervasive and radical. The blockchain technology is pervasive because of its ability to offer diverse services from a cryptocurrency to a supply chain. The second condition requires the adopting organization to deviate from its existing processes. The blockchain technology is the first to allow unrelated people to reach a consensus on the occurrence of a particular transaction or event without the need for a controlling authority (Siba & Prakash, 2016).

The DDI model recognizes the degree to which there is a significant transformation in governing architectural principles and development processes. DDI expects a qualitative change to respond to architectural changes in the IT base, which is also a required element for DDI to exist. A DDI weaves together a set of interrelated technological and organizational changes (Teece, 1986).

As shown in Figure 2, Lyytinen and Rose (2003) divided IT innovations into three subcategories according to the impact of a change: innovations in the system development process; innovations in which the uses of IT affect business functions; and innovations that involve changes to the available computing. The three innovations shown in Figure 2 represent the DDI model, which can be divided into subgroups, depending on the nature of the innovation. The authors established three sets of interdependent innovations. This mutual dependence may result in the emergence of innovations in another innovation set.

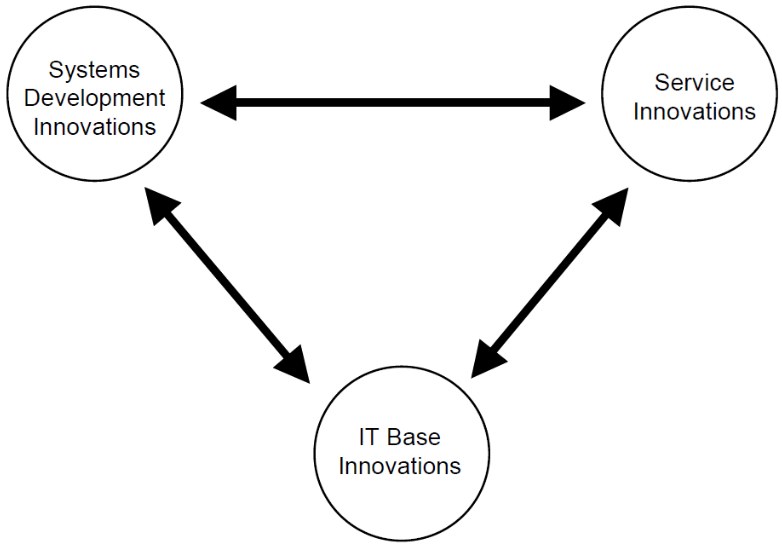


Figure 2. Disruptive digital innovation model

Lyytinen and Rose (2003) developed a DDI model that considered technological changes, which constituted a radical transformation in the governing architectural principles and development process. This model helps to distinguish between disruptive and incremental IT innovations. The authors established three interdependent sets of innovations: systems development innovations, service innovations, and IT base innovations. In the model, mutual dependence may result in the emergence of innovations in another innovation set.

DDI offers a powerful means for broadening and developing new markets by providing a new functionality that may disrupt existing organizational technology practices (Christensen & Bower, 1996). Christensen's 1997 thesis on disruptive technology continues to be highly regarded by managers (Tellis, 2006). According to Christensen (1997), disruptive technologies provide values that differ from mainstream technologies. Moreover, the technology is initially inferior to mainstream technology. The term disruptive technology is used synonymously with the term disruptive digital innovation to widen the application of the theory to include not only technological products but also services and business model innovations (Dan & Chang Chieh, 2010).

Although the classification terminology has evolved over time, in mainstream academic studies, technological innovations have been divided into two classes: 1) disruptive, radical, revolutionary, discontinuous, breakthrough, and emergent; 2) incremental, evolutionary, and continuous (Dan & Chang Chieh, 2010). Disruptive and incremental innovations have different competitive consequences because they require entirely different organizational capabilities (Henderson & Clark, 1990). Incremental innovation strengthens the capabilities established in organizations, whereas DDI forces organizations to ask a new set of questions, draw on new technologies, and implement new problem-solving approaches (Ettlie, Bridges, & O'Keefe, 1984).

III.8 Disruptive Digital Innovation in Information Technology

The origins of DDIs are in digital technology (Teoh, 2016). As scientific research continues, and the rate of change in technology increases to meet consumer demands, new digital technologies are continuously developed. According to Christensen and Rosenbloom (1995), digital technology may transition to digital innovation in the presence of appropriate environmental conditions, such as mature technological infrastructure and consumer demand (Porter, 1990). The successful transition from digital innovation to DDI is dependent on organizational capabilities and environmental conditions (Clayton M. Christensen, 2006; Lyytinen & Rose, 2003). According to Christenson (1997), mature organizations are typically better positioned to introduce DDIs. However, start-up IT organizations tend to outperform larger, more established and resource-rich ones (Walsh et al., 2002). The continuous advancement of DDI capabilities could be implemented to enhance interfirm IT capabilities, such as blockchain technology (Rai, Pavlou, Im, & Du, 2012).

III.9 Disruptive Digital Innovation and Organizational Learning

Innovation in information technology can be defined as DDI (Swanson, 1994). Most IT-enabled DDIs augment organizational work processes or organization structures (Lyytinen & Rose, 2003, 2006). IT innovations become disruptive when there are drastic shifts in organizational structures, and new solution designs are required. When DDI is introduced into an organization, it significantly changes the architecture of the work practices and team member dynamics that are critical to the expected outcomes. Digital innovation penetrates an organization through a series of complex, interrelated innovations.

As an organization faces new challenges, the need may arise to evolve the already established standards and guidelines to account for novel experiences. IT innovations do not form a singular event from a wish to learn, but they often subsume a series of changes that may depart from existing practices (Lyytinen & Rose, 2006). A key aspect of operational learning is measuring the effectiveness of development processes in solving recent problems and determining ways to restructure standards and guidelines to realize the desired outcome. As innovations become increasingly complex and create new organizational structures, the need for learning increases as well as the difficulty in carrying out effective learning (Argyris, 1976). Although the usefulness and constraints of single-loop and double-loop learning theories have been examined in the context of business IT organizations, very few studies have examined these theories in the context of technology organizations that embrace DDI. In their early study, Argyris and Schön (1976) suggested that organizational learning enables an organization's ability to embrace DDI.

III.10 Blockchain as a Disruptive Digital Innovation

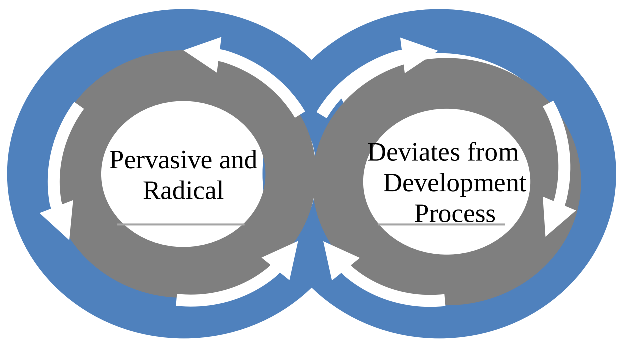
Blockchain is a disruptive technology that has been predicted to create fundamental changes in the way businesses are managed (Samuels, 2017; Siba & Prakash, 2016). The blockchain technology has been described as "the biggest disruptor to industries since the introduction of the Internet" (PWCHK.com, 2016).

The blockchain provides a shared system for mediating trust and selective transparency (Casey & Wong, 2017). Blockchain, which is a novel technique, can ensure the security, privacy, and consensus of all players (Siba & Prakash, 2016). The blockchain technology dramatically changes the structure of work processes, such as order tracking, fulfillment, and inventory control. A core capability of blockchain is that every member of the network can inventory the blockchain and thus be a peer partner with equal access to information. The blockchain technology inherently allows peer partners to share information without the need for a trusted central institution (Tapscott & Tapscott, 2017).

Blockchain is based on several central concepts that are key in technology: immutability, decentralization, and transparency. Immutability is reflected in the fact that once a transactional record is placed on the digital ledger, it cannot be deleted (Narayanan, 2016). The blockchain technology enables the fast and secure peer-to-peer transfer of value without relying on third-party intermediaries. This capability allows blockchain technology to create a digital platform that integrates business and technical processes across multiple organizations.

The blockchain technology is the core system that underpins the cryptocurrency Bitcoin, in which the computers of separately owned entities are programmed to follow a cryptographic procedure to validate a commonly shared financial ledger. The decentralized nature of blockchain technology enables the creation of currencies that are independent of any central regulator.

Transparency is another central feature of blockchain. All transactions are not only distributed but also publicly auditable (Regoriou & Pak, 2015). This information transparency significantly reduces organizational interdependency as well as the expenses caused by information irregularity.



<u>Pervasive and radical</u>
Blockchain technology qualifies as pervasive for its ability to offer disparate services from cryptocurrency to supply chains.

<u>Deviates from existing development processes</u>
Blockchain permits unrelated people to reach transaction consensus without a controlling authority.

Figure 3. Blockchain as disruptive digital innovation

Originating in information technology, DDI has a pervasive and radical impact on development processes and solution delivery. As shown in Figure 3, the blockchain technology qualifies as a DDI based on two factors. First, it is pervasive and radical because in addition to financial services, it offers services that allow a wide range of organizational processes, such as SCM, to fundamentally change the ways in which businesses are managed. Second, blockchain deviates from existing development processes. As a DDI, blockchain requires new architecture and development processes that deviate from existing development processes, which improves software solutions.

IV CHAPTER IV – RESEARCH DESIGN AND METHODOLOGY

In this study, a qualitative case study design was used to investigate how DDI was managed in an IT organization to understand how it contributed to the organization's ability to learn. Qualitative methods are widely used to comprehend people's actions and dialogs as well as the contexts in which critical decisions are made (Myers, 2009). Context, accompanied by the ability of the sample to "talk," is a primary motivation for qualitative research (Myers, 2009). This research method satisfies the three boundary conditions established by Yin (2009): (a) "how" a research question is posed; 2) references are made to contemporary real-world events; (c) in which we there is no governing control. In the following section, the single case study is presented in detail, including the research question, the unit of analysis, and the justification for the site selection.

IV.1 Research Design

This research was designed as an embedded case study that was conducted over the period of one year. The case study method has proven effective in researching complex social phenomena, including distinct life cycles, actions by small groups, and organizational processes (Yin, 2009). The case-study method allows us to capture complexity, and the engaged scholarship model provides rich insights into the design, data collection, and analysis of the cases being examined (Van de Ven, 2007).

Table 4. Data Collection Strategy

Data Collection Strategy	
Data Collection Source	Data Collection Details
Primary Data Sources	• 1 year of project observations • Detailed analysis of the highly structured eight-week development phase
	• Semi-structured interviews with project participants
Secondary Data Source	• Organizational process documentation,
	• Publicly available publications

The research was conducted from a process point of view by utilizing a qualitative case study approach in which semi-structured interviews served as the primary sources of data. Interviews were conducted with individuals in varying roles and at hierarchical levels in SupplyChainCo, which in this study is the pseudonym of a global supply chain company. The diversity of the participants provided several important perspectives.

SupplyChainCo conducted a one-year project, which included the eight-week development phase. The decision-making body included 10–15 executives, including the vice president, managing directors, and IT directors. The CIO of the organization was provided with regular updates on the status of the project. Table 5 lists the stakeholders that were involved. The project yielded more than 40 hours of audio recordings, which resulted in a rich data set. When necessary, additional interviews were completed to provide clarification. The meetings and interviews served as primary data sources. The secondary qualitative data sources included organizational process documentation and summary notes taken during the observations.

Table 5. Summary of Information about the Research Participants

Summary of Information about Research Participants		
Reference ID	Roles of Interviewees	Number of Participants
1 2 3	Senior Executives 1 Chief Information Officer 1 Chief Financial Officer 3 Vice Presidents	1 1 6
4 5 6 7	Senior Managers 1 Managing Director, Business 1 Senior Director, Business Development 2 Directors, Business Development 2 Directors, Information Technology	2 2 3 5
8 9 10	Managers 1 Sales Manager, Business 5 Managers, Information Technology 2 Managers, Strategic Sourcing	3 4 4
11 12 13 14 15 16	Individual contributors 2 Technical Product Owners, Business Development 11 Engineers, Information Technology 2 Principal Engineers, Research and Development 1 User Experience Designer, Information Technology 1 Project Leader, Business Development 3 Blockchain Solution Engineers, Research and Development	4 11 3 1 7 4

The research method included participant observations. As a participant observer, the researcher had access to data, potential interviewees, and project documentation (Yin, 2009). In addition, as a participant observer, the researcher was immersed in the organization and understood the existing culture (Coghlan, 2001).

Because the researcher was a participant observer, the possibility of participant bias was proactively mitigated to protect the validity of the research. One of the measures included having a secondary researcher review the first researcher's observations and findings. Based on the researcher's goal of understanding how organizational learning impacts the implementation of disruptive innovation, attention was given to determining whether the participant observer's viewpoints were in alignment with those of the other project participants, which was achieved during debriefing meetings with the participant researcher and the secondary researcher.

Site selection. SupplyChainCo represents the large technology division of an organization focused on a supply chain. The organization, which is a Fortune 500 company with representation around the world, was selected for this research. A single case study was justified because the study was focused on a contemporary phenomenon with strong contextual dependencies and advanced technology. The selection of SupplyChainCo as the study site was driven by intentional theoretical sampling (Yin, 2009). The selected company was an IT organization that was undergoing a digital transformation aimed at reducing financial risk and increasing differentiated advantage through technology. The digital transformation conformed to several design principles of not only the direction of the organization in increasing investment but also where the investment is limited. According to the organization's CFO, the IT organization "continues its journey of transformation, and the results indicate that we are moving in the right direction." The mission of the transformation was to equip the IT organization to serve as an essential partner in business by ensuring that technology provides a competitive advantage. A significant investment in the technology division had supported operational improvements and enhanced efficiency, consistency, and visibility. As a part of the digital transformation, the organization successfully implemented the disruptive technology, blockchain.

Focal Project

This study conducted an in-depth examination of the disruption of the SCM process by blockchain technology. Blockchain transforms how businesses make transactions across organizations. The concept of a shared ledger disrupts traditional business processes, causing them to be refined. The study involved participation interviews, project documentation, project meetings, and conversations, which were intended to lead to innovative delivery in Project Trilogy (a pseudonym for the focal project), which was the focus of the research. As an implication of the research situation, the researcher manager had access to the project's complete software development lifecycle.

SupplyChainCo sponsored Project Trilogy, in which two other organizations participated: Blockchain Logistics (BCL) and Blockchain Supplier (BCS). BCL is a fictional name that represents one of the world's largest logistics companies. BCS is a global commercial and consumer technical product developer with a global workforce. Both BCL and BCS are significant strategic partners of SupplyChainCo.

Each organization was responsible for the costs and expenses it incurred in completing the project. Neither party received payment for the performance of its obligations. The researcher was an executive leader in SupplyChainCo and led Project Trilogy. Hence, the researcher was engaged in the full software development lifecycle of Project Trilogy, which included informal and formal engagements. Manager-researchers have the advantages of knowledge and experience, which aid in studying organizational learning (Coghlan, 2001).

The main objective of the project was that SupplyChainCo, in partnership with two major IT organizations, would test the business value of a blockchain-based system for distributed ledger technology (DLT) using the supply chain status information provided by each organization. The assumptions and responsibilities of all parties were specified in a non-disclosure agreement prior to the start of the Blockchain Project (BCP).

Within the scope of the BCP, the three-organization project team developed a set of components to track and trace internal company purchases, which is commonly referred to as COMAT: the combined abbreviations of company (CO) and materials (MAT). The term COMAT is an industry standard used in SCM, and it is generally used to describe the wide array of company materials required to conduct business operations.

The goal of the Trilogy Project was to provide technical learning by implementing a blockchain solution. As a secondary benefit, SupplyChainCo used the findings from this BCP to help determine whether there were clear business benefits of implementing a production solution.

This research was designed as a rigorous and relevant qualitative study to achieve a deep, credible understanding of the phenomenon (Trochim & Donnelly, 2001). In engaged scholarly research, it is difficult to transform the investigation of real-world problems into the creation of new knowledge. A participative approach was used to increase the study’s relevance to practice by gaining the perspectives of key stakeholders (Van de Ven, 2007).

IV.2 Data Collection

A case study protocol that contained an interview guide, procedures, and general rules (Yin, 2009) was developed. The literature on organizational learning guided the development of questions that were designed to reveal how the learning process was manifested in the organization. Approval for the study was sought from the Institution Review Board (IRB) at Georgia State University prior to the data collection. As recommended by Yin (2009), the data collection plan was drawn from multiple sources, including archival data, project progress reports, process documentation, and interviews with project team members and leaders. Conversations were recorded for data collection and referenced during the data analysis.

Organizational archival data and project data were collected from the study participants. As a participant observer, the researcher had unlimited access to Project Trilogy data and organizational archival data. The organization's historical records and all findings in the data collection were treated with confidentiality. The project and archival data were used in the triangulation of the research findings from the research interviews and team member observations.

The single-site case study's unit of analysis was the blockchain development project. The number of subjects participating in the interviews is shown in Table 5. They were selected based on their knowledge and expertise in the area. The participants' roles included technical manager, technical expert, director, and vice president. The subjects selected to participate in this study had extensive experience in the field, and they made decisions about technology and organizational structure. The secondary data collected for the study included status reports and project documentation. The concerns that the participant observer interacted with many participants and interpreted the events according to the context are acknowledged. For example, a single observer is highly unlikely to be able to record all events associated with organizational learning. In addition to this limitation, individual intentions and motives were rarely explicated by the participants.

The data collected in the field as the events occurred were cataloged, and the interviews were transcribed. A map of the key events and sequences was created based on the interview data, the secondary data, and the researcher's observations.

IV.3 Data Analysis

The data analysis was an iterative process of theoretical interpretation and data examination. In alignment with Klein and Myers (1999), the data analysis utilized dialogical reasoning combined with the prior research literature. The identification of key concepts, organizational processes, and relationships was the focus of the data analysis. The utilization of dialogical reasoning facilitated the emergence of new insights and themes.

It is recommended that in qualitative research, the data analysis be executed in parallel with the data collection (Mason, 2002). The data analysis occurred in multiple iterations, resulting in numerous opportunities to evaluate the plausibility of the results. During the initial iteration, the goal of the data analysis was to understand the experiences of the participants, define relationships, and uncover pattern sequences in the data. The subsequent phase involved multiple reviews of the consistency of the findings that emerged from the iterations of the data analysis. The analysis was focused on qualitative changes in organizational learning and their outcomes in response to the implementation of blockchain.

Assuring rigor and validity. In alignment with Yin (2009), the rigor of this research was validated through the four conditions outlined in Table 6: construct validity, internal validity, external validity, and reliability. During Project Trilogy, three major organizational learning themes were discovered.

Table 6. Case Design for Rigor and Validity

Case Design for Rigor and Validity		
Test	Case Design	Application
Construct Validity	Multiple Source of Information	Meetings and interviews served as primary sources of information. As needed, additional informational interviews were completed to provide clarification.
	Validation of Information Collected	
Internal Validity	Matching Patterns	Interview material was analyzed against project material for consistency in explanations.
	Examine Rival Explanations	
External Validity	Single Case Theory	Used double-loop learning in organizational learning.
Reliability	Executed Case Study Protocol	Executed case study protocol, including an interview guide, procedures, and general rules.

V CHAPTER V: FINDINGS

V.1 A Blockchain Implementation Learning Journey

V.1.1 Dynamic Market for a Technology Organization

As in most IT organizations, SupplyChainCo was continually faced with a dynamically changing market that was disrupted by advances in technology. To guide SupplyChainCo's vision of making technology a competitive advantage and reducing operational costs, a blockchain initiative was conceived. The company was interested in exploring the blockchain technology and learning how it would help the organization simplify complex supply chain processes and advance technical learning.

> *The trial-and-error process gives us an opportunity to focus on learning about blockchain and its potential impact on our operational business. (4, Managing Director)*

An IT organization is an appropriate setting for the study of organizational learning through DDI. A high-tech service organization designed to produce its technology products and services, SupplyChainCo was also a world-renowned organization characterized by innovative technology as its primary capability. The organization's mission was focused on transforming the legacy sector company with significant investments in innovation and technology. The organization could no longer define itself by the services that it currently provided for its customers.

> *We are a technology-driven supply chain company operating across the world, but at our core, we are a tech business. To stay ahead of these changes and outpace the competition, SupplyChainCo continues to drive digital and cultural transformation is our*

organizational mission. Our organizational mission makes us an ideal organization for innovation that challenges the status quo. (3, Vice President)

Blockchain technology, an IT-based innovation, represents a dramatic change in how information is shared, verified, and stored by organizations. When asked to describe blockchain as a technology, a senior executive in blockchain logistics said the following:

Developing a blockchain solution is an evolutionary journey. No one (person) can whistle a symphony. It takes a whole orchestra to play it. Blockchain is a foundational technology, and we look forward to leveraging blockchain technology to solve critical customer needs. (7, Director)

V.1.2 Digital Transformation Journey

In 2018, SupplyChainCo continued its technology transformation, and the results indicated that the organization was on its desired trajectory:

The results of the past year indicate we are moving in the right direction. (2, CFO)

For the first time, SupplyChainCo won the Supply Chain Excellence Award, which is the gold standard award for supply chain excellence. This most prestigious award in the supply chain industry signaled the achievement of the company's three-year goal. The organization's investments in technology and operations had produced solid financial gains.

In many regards, (SupplyChainCo) has taken the road less traveled, differentiating ourselves from competitors.... [SupplyChainCo remained] *"focused on innovation, in alignment with the organizational initiatives. (7, Director)*

The selection of an appropriate business case is paramount when a DDI is introduced. Triangulation must exist between the immediate business problems, the future financial gains resulting from the solution, and the costs of the current disruption to the business operation. In addition to financial gains, DDI has the potential to provide significant intellectual property (IP).

V.1.3 Disruptive Nature of Innovation

The blockchain technology has the potential to have a profound impact on how organizations perform their SCM functions. Because blockchain has the potential to disrupt supply chain business models, it may eventually help organizations move away from indirectly serving customers through other organizations to direct consumer-based applications, thereby achieving faster operational transactions and organizational savings.

The blockchain technology also eliminates the need for intermediaries in supply chain transactions, such as credit card companies, which impede the transaction process. Project Trilogy demonstrated the ability to create a P2P blockchain that allowed multiple trustworthy relationships and created immutable records of transactions. The blockchain technology is the intermediary that facilitates transactions among various business partners. We illustrate this function by a typical scenario depicted in the supply chain storyboard, as shown in Figure 4.

The blockchain story begins when SupplyChainCo experienced an inventory shortage that required additional handheld scanners in its operational warehouse. The organization did not have any available scanners within the supply room, so the decision was made to order them. SupplyChainCo generated the purchase order (PO) and called the BCS service desk to place the order. This traditional process resulted in data errors, poor visibility, and a single point of failure.

The BCS received the PO for the handheld scanners from SupplyChainCo. Then the BCS sent the request to the fulfillment center to ensure that it could be sent to SupplyChainCo as soon as possible. As shown in Figure 5, each step in the business process was recorded on the blockchain, thus eliminating the need to request a status. The introduction of the blockchain immediately created visibility and transparency, thus enabling SupplyChainCo and the BCS organizations to view the status and accuracy of the PO.

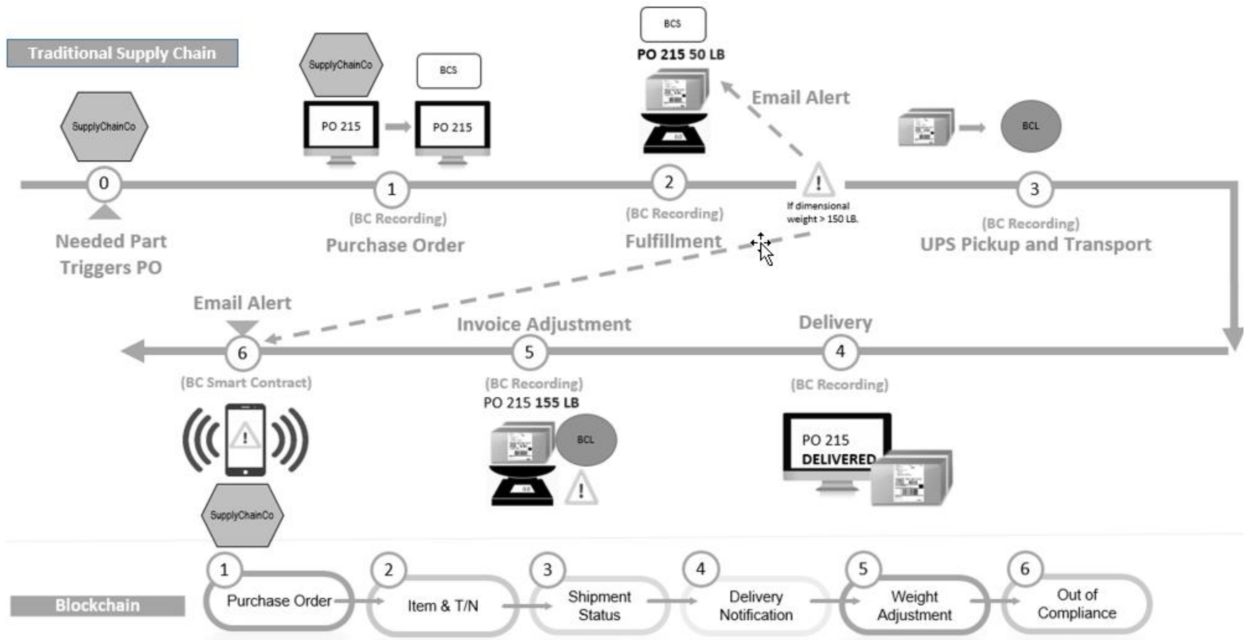


Figure 4. Visual supply chain storyboard

The business rules regarding the logistics procedures that must be adhered to in transporting SupplyChainCo's COMAT were included in the static shipping guidelines. These guidelines included the specific transportation methods and the logistics company that should be used. The BCS was required to adhere to the rules of SupplyChainCo's shipping guidelines. As reflected in the supply chain storyboard, the BCL should only be used to transport shipments that weighed less than 150 pounds.

The BCS produced a shipping label, and the BCL picked up the shipment. The BCS updated the system to reflect that the PO was fulfilled and that the package was in transit. The blockchain solution prevented the BCL from being contacted if the shipment was not in compliance with the shipping guidelines, and it provided transparency in the state of the shipment. Prior to the BCP, a lengthy reconciliation process would be invoked, and the BCS could be fined for being non-compliant with the shipping method.

The BCL systems showed that a label had been generated, so a logistics employee picked up the scanner shipment. At the logistics warehouse, the package was re-weighed, and the billable weight was placed on the blockchain. The transfer of data is depicted in Figure 5.

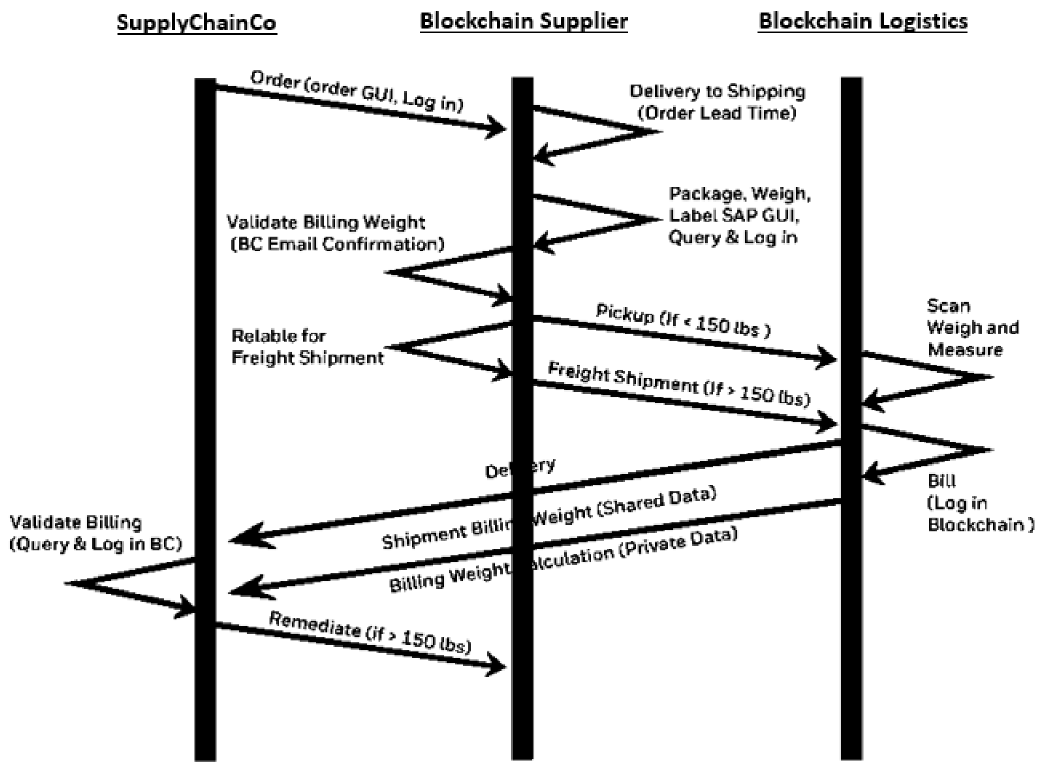


Figure 5. Supply chain data flow

Blockchain technology offers the distribution of information that is verified and cleared continuously over the peer network. The distribution of information across the network results in the transparency of the supply chain. SupplyChainCo approved this project to proactively seek ways to reduce logistical expenses in moving COMAT. The BCS and BCL organizations were invited to participate because they were also focused on technology-enabled innovations. As an added benefit, the shipping guidelines compliance use case was relevant to all three organizations.

Table 7. Supply Chain Storyboard

Supply Chain Storyboard			
Visual	SupplyChainCo	Blockchain Supplier	Blockchain Logistics
Steps 0 and 1	SupplyChainCo of a handheld scanner. SupplyChainCo does not have any available supply room so will have to order this part. The PO is generated, and a is made to BCS to place the order.	BCS receives a PO from SupplyChainCo. BCS will confirm availability within its fulfillment center. The shipping guidelines show that this shipment will be delivered to SupplyChainCo via BCL.	
Step 2		BCS makes a shipping label for BCL to pick up the shipment.	
Step 3		BCS updates the system to show PO has been fulfilled and the shipment is being fulfilled.	Blockchain logistics shows that a label has been generated and the driver is in route for daily pick up.
Step 4			The warehouse weighs to populate the billable weight for the package.
Step 5			The financial adjustment is made in the system of record.
Step 6 (Exception Handling)	SupplyChainCo has received an alert that the package is not compliant with the shipping guidelines.		The driver has scanned the package as picked up and available for

			SupplyChainCo tracking.

As shown in Figure 6, the blockchain supplier measured the weight of the shipment and recorded it at 50 pounds. This information was published in the blockchain, which communicated non-compliance with the shipping guidelines. However, when BCL communicated the billable weight, it resulted in shipping compliance. The blockchain technology made visible the system mismatch of the shipping weight to all members of the network.

After further research, it was determined that the BCS did not include the shipping box dimension factor in the weight calculation. If the BCS had used a shipping box dimension factor within the weight calculation, the scanner shipment would have been non-compliant with the guidelines for shipping through BCL.

V.2 The Learning Process through Disruptive Innovation

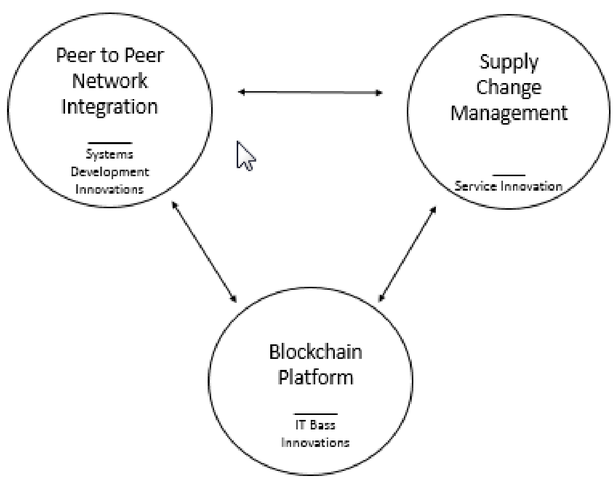


Figure 6. The blockchain disruptive digital innovation model

This study was aimed to answer a research question regarding organizational learning through DDI, namely, the implementation of blockchain technology. Accordingly, in this research, the learning process is organized into subsections that are aligned with the IT DDI model shown in Figure 6. The IT DDI model has three constructs: IT base innovations; IT system development innovations; and IT service innovations. These constructs will be used to describe the qualitative changes required to support the implementation of SupplyChainCo's blockchain platform. The blockchain implementation reflects the series of actions and learning points. The process study identifies critical encounters or episodes and determines the relationship between preceding events and their consequences.

Table 8. Blockchain IT Innovation Set

Blockchain IT Innovation Set		
IT Innovation Set	Description	
IT Base (Base)	Base Development Capability Innovation	Blockchain Platform: Network participants must develop a peer-to-peer network that simulations protect the member organization and propel the transparency initiative.
	Base Technology Innovation	
System Development (SD)	Administrative Process Innovation	Process Management: Network participants must develop a rapid process for decision making across technical, business, and strategic domains.
	Supply Chain Management	
Services (S)	Technological Services Innovation	Network Integration - Integrating

		heterogeneous computational data over the blockchain network.

V.3 Blockchain-enabled Organizational Learning

The blockchain-enabled organizational learning framework (Figure 8) was developed based on the results of the data analysis conducted in this study. It was observed that the organization experienced a DDI that was characterized by a pervasive and radical impact on the business processes and the software development process. The organization responded to this DDI through organizational learning specifically by implementing single- and double-loop learning strategies. As shown in Figure 7, double- and single-loop learning are similar because both allow errors to be identified and corrected through the feedback loop. However, in double-loop learning, the governing elements are reviewed and reconsidered, whereas in single-loop learning, the organization's design and goals are not disrupted (Argyris, 1976).

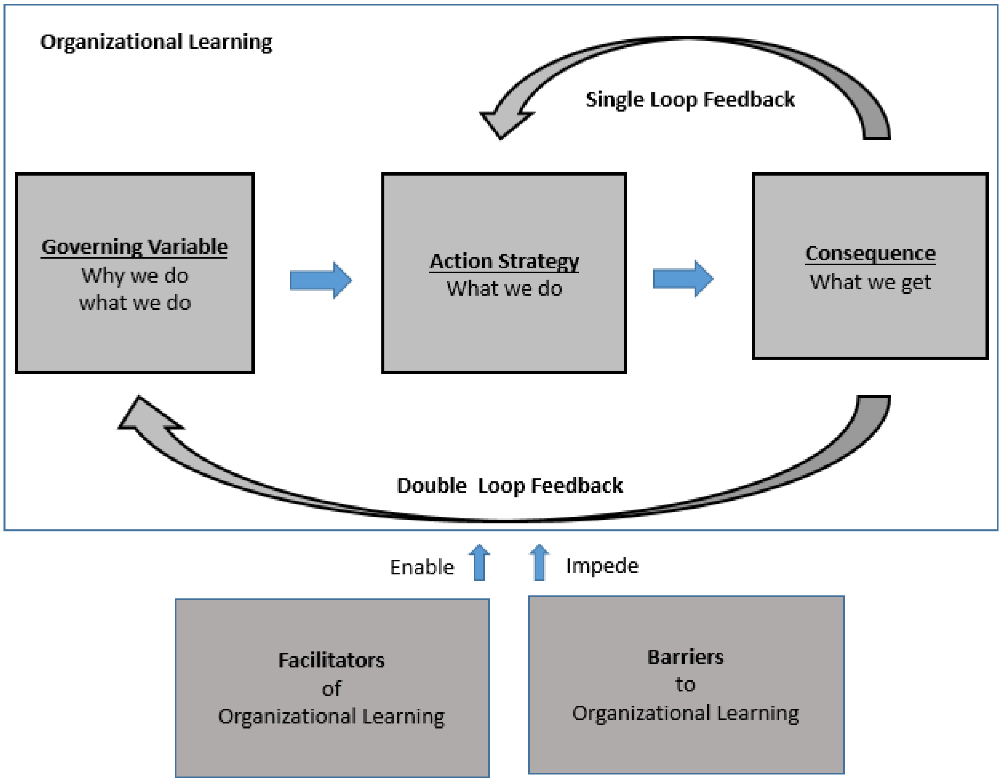


Figure 7. Blockchain-enabled Organizational Learning

Disruptive innovations often result from a new technical capability or architecture that differs from the existing capabilities or architecture, which improves the performance trajectory. The disruption requires the adopting organization to deviate from existing business and software development processes, which necessitates organizational learning.

> *Blockchain is different from any existing technology that we have today within the SupplyChainCo. With these technical differences, we are expecting to make changes to our processes that benefit our performance. (11, Product Owner)*

The innovations enabled by blockchain technology are currently disrupting the supply chain industry. The characteristics of immutability, decentralization, and transparency can help transform current processes, but these transformations require that organizations learn and respond to them. These capabilities trigger organizational learning, specifically single-loop learning with action strategies and double-loop learning that questions governing variables. In addition, the blockchain-enabled organizational learning framework identifies factors that facilitate organizational learning (e.g. process agility, commitment to innovation, and blockchain characteristics). In addition, the framework includes barriers that hinder organizational learning when a DDI, such as blockchain technology, is introduced. In the following section, the blockchain-enabled organizational learning framework is described in detail in conjunction with the contextual environment and the process through which organizational learning is achieved.

V.4 Organizational Learning and Organizational Inertia Strategies

The existing organizational inertia, including political norms, economic constraints, and psychological frames, frequently constrains an organization's learning ability in response to DDI. In the present study, the data analysis identified the following strategies in response to organizational inertia: commitment to innovation for organizational resources, ability to acknowledge and respond to changes in business processes and relationships, and the organization's ability to respond to innovation.

> *Change is hard! There are multiple forces that keep organizations "operating as usual." However, our secret sauce is that we are thoughtful, reliable, and innovative in the face of these challenges. We must be thoughtful in how we utilize our resources, reliable in our business processes to meet the needs of our customer and innovative. We are an old company looking to reinvest each day to separate ourselves from the competition. (3, Vice President)*

In the following section, we describe in detail how the blockchain implementation enabled the strategies that were used to respond to the forces of inertia.

V.5 Intermediaries in Innovation – Learning Case 1

The introduction of blockchain, a DDI, created opportunities for organizational learning in SupplyChainCo.

> *The (blockchain) technology is still young; now is the time to experiment and learn by trial-and-error. (4, Manager)*

In the supply chain network, the organization often relied on formal intermediaries, such as freight forwarders, to address impediments in the communication among multiple parties in the supply chain network.

> *The freight forwarders play many roles including: agent, consultancy, packaging, clearance, documentary, consolidation, insurance, logistics, fiduciary, and overseer. Just to name a few. (10, Manager)*

Freight forwarders are instrumental in the distribution of financial records, such as bills of lading. The bill of lading, which contains the terms and conditions of the shipment, is issued and disseminated by the freight forwarder. Freight forwarders typically organize and manage information, but they are rarely involved in the movement of freight. Freight movement can be by sea, air, road, or rail, depending on what the freight forwarder deems the most effective transportation mode. The bill of lading created by the freight forwarder includes the multi-carrier working agreements required to support various modes of transportation.

One of the most complicated roles played by a freight forwarder is legal fiduciary. Traditionally, the freight forwarder acts as an agent for the shipper and enters into agreements with multiple carriers on behalf of the shipper. The carriers are then responsible for the movement of the goods. However, in disputes involving negligence, freight forwarders can also be held liable because they also represent the carriers. Consequently, they have the dual role of representing the shipper and the supply carriers according to an established agreement.

This dual role is widely accepted in the industry. (8, Manager)

The establishment of trust is a critical requirement for the success of freight forwarders in their dual role. The information provided by the freight forwarder must be trusted to fairly represent the shipper and carrier; this trust is typically earned over a long period.

SupplyChainCo have trusted long-standing relationships with several freight forwarders. They are often considered an extension of the team. (Manager, 10)

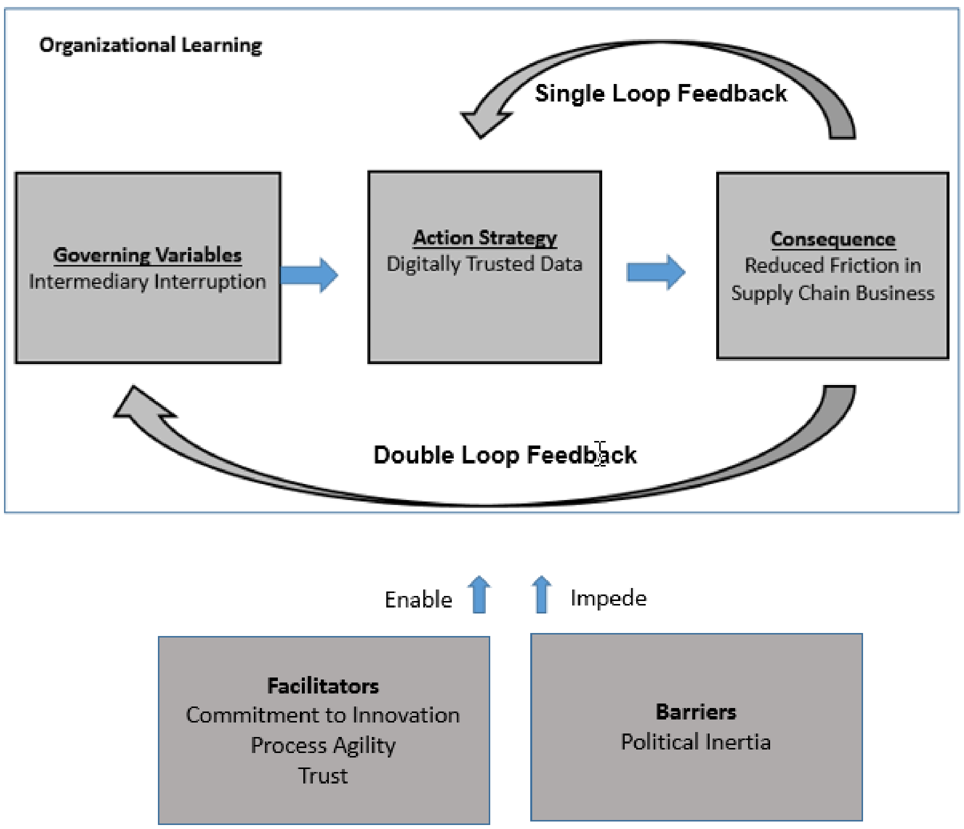


Figure 8. Intermediaries in Innovation-enabled Organizational Learning

V.6 Governing Variable – Immutability

The blockchain technology enables the direct dissemination of information among the parties involved in a transaction instead of brokering it through a trusted intermediary. Blockchain's inherent capability of immutability creates tension in the role of the freight forwarder as a trusted intermediary in the dissemination of information. Hence, the information shared on the "*supply chain must be unbiased, and accurate" (Engineer, 16)*. When information is written on the blockchain, it is nearly impossible to remove or modify it. The blockchain achieves digital trustworthiness through the verification of information by multiple organizations on the blockchain network.

> *Blockchain enabled every organization on the network to have an individual copy of the data. This is drastically different from the freight forwarders disseminating data to network constituents via fax and API(s). (16, Engineer)*

Organizational inertia, particularly political inertia, challenged SupplyChainCo in achieving organizational learning. SupplyChainCo had a long-lasting business partnership with freight forwarders, who had created specific routines and dependencies among themselves. The existing business routines and professional relationships were barriers to the adoption of the DDI. Political inertia was expressed in the initial reluctance to disrupt the business partnership with the freight forwarder.

> *The relationship with freight forwarders has proven to be a reliable partner over the years providing trusted supply chain information. The thoughts of disrupting this relationship were unsettling. (Manager, 10)*

V.7 Single-loop Learning

The adoption of blockchain eliminated the need for freight forwarders within the COMAT shipment, which could result in an additional loss of revenue in other markets. In the organization, there was strong political inertia to maintain the existing partnerships and prevent the potential loss of revenue by the freight forwarders. Political inertia discourages disrupting existing business partnerships to avoid retaliation that could result in the loss of future business with the freight forwarders. In SupplyChainCo, the political inertia encouraged only the refinement of the existing processes that included the freight forwarders, therefore limiting the full utilization of the benefits of the blockchain technology.

For example, the organization was engaged in initiatives to improve communication within the supply chain by enhancing the speed at which the information was communicated.

> *We are always seeking to improve the flow of information. Through the years we have communicated via fax, EDI [electronic data interchange], and API(s) [application program interface] all in efforts to increase the speed in which information is provided. (Engineer, 12)*

A facsimile, or fax, is the telephone transmission of information that is printed on paper. The EDI is an electronic exchange of information that eliminates the need for the dissemination of information on paper. However, EDI requires a standard format that is specified by the industry. The EDI standard requires the message to adhere to a strict sequence. The use of EDI reduces the human interactions involved in sending and receiving a fax. The API is a more flexible communication interface than the EDI is. APIs communicate data through a predefined method or object that allows access by applications within and outside the organization. The use of fax, EDI, and API successively by SupplyChainCo was intended to improve how the information was shared among the parties involved in supply chain transactions. However, the freight forwarders continued to serve as the centralized source of information.

Single-loop learning enabled incremental improvements in efficiency within the existing business partnerships. In the progression from fax to API, the freight forwarders shared information more quickly with their shipping constituents, which resulted in the faster dissemination of information. Limited by the freight forwarder’s centralized source of information, data cannot be continuously verified through corroboration among multiple sources of information. In contrast, in the blockchain network, verification is derived by consensus, and each organization on the network has its own copy of the data, that is, the digital ledger.

> *Improve information sharing through programmatic changes that increase the speed of information delivery is considered incremental improvements, but there are limitations. (13, Engineer)*

The action strategy increased the speed at which the information was disseminated, and it limited the need for human interaction. However, the action strategy fell short of creating the real-time distribution of continuously verified information across the supply chain network.

V.8 Double-loop Learning

The ability of SupplyChainCo to experience DLL was facilitated by several factors, including the commitment to innovation and process agility. SupplyChainCo’s commitment to innovation was a key facilitator of organizational learning.

> *Commitment to innovation is not a fad within the organization. It is discussed regularly during our organizational meetings and is represented in our organizational values. (3, Vice President)*

The organization’s commitment to innovation empowered the leader to request the team to determine whether blockchain could be a viable solution despite the existence of political inertia. When it was deemed a viable solution, the organization funded the implementation of blockchain. The funding decision by the leaders reflected the organization’s priorities and commitments.

> *The desire to innovate was backed by funding from our senior leaders. This demonstrated their commitment to innovation at the most senior levels. (11, Product Owner)*

Second, process agility enabled the organization to make process changes to take full advantage of blockchain's capability, which enabled the adaptation to DDI. The leaders of SupplyChainCo facilitated organizational learning by enabling the team to make process changes. The commitment to innovation empowered the employees within the organization to review and amend business and technical processes to take full advantage of the benefits provided by blockchain technology. The vice president of SupplyChainCo stated the following:

> *We are about results. Achieving results may require changes to our existing process. We cannot get stuck in the past or the stuck with old processes that served us well in the past. We are committed to making changes that best serve our customer. (3, Vice President)*

The team's commitment came from the senior leadership, and it was reinforced by the project manager. Employees who were committed to innovation were deemed essential for the successful implementation of blockchain technology:

> *Our manager was key in empowering the team. We were encouraged to innovate and fail fast by every level of the organization. Having senior leader support that was reinforced by management created a consistent message. (13, Principle Engineer)*

In alignment with the organization's commitment to innovate and improve process agility, the leaders actively supported the initiatives to transform the organizational processes. One senior director stated, *"leaders are required to challenge the status quo and be open to examining existing processes" (5, Director).*

The commitment to innovation was a component of SupplyChainCo's organizational strategy, which provided leadership with guidelines for making decisions that directly influenced the action strategies. The leadership had the momentum that was necessary to deploy action strategies that were aligned with the organizational strategy. Specifically, this organizational strategy provided momentum to challenge the need for intermediaries.

Project Trilogy created the opportunity for senior management to recognize the digital trust enabled by blockchain technology and thus the opportunity to reexamine the need for intermediary partnerships that were designed to provide this trust.

> *As a leadership team, we were able to independently observe the immutability of blockchain. The [BCP] allowed the characteristics of blockchain to move from theoretical to realization. With the blockchain, transactions are recorded in a vast distributed peer-to-peer network that verifies the transactions, eliminating the need for a single intermediary like a freight forwarder. (7, Director)*

The blockchain technology facilitated the distribution of information across the network, which was verified continuously by BCS and BCL. As peer organizations on the network, BCS and BCL had their own copies of the distributed ledger. Moreover, every time an organization submitted a transaction to the ledger, the validity of the information was verified.

> *We can trust the information of the blockchain since multiple copies of the same information exist. "In some instances, blockchain has the potential to eliminate the need for intermediate business partnerships. (Engineer, 16)*

The team recognized that blockchain technology distributes information in real time. This capability could reduce or eliminate the reliance on freight forwarders, thereby decreasing their role as primary distributors of information. The team also learned through the project that trust was no longer required to be orchestrated by a third-party intermediary, such as a freight forwarder.

Project Trilogy provided the opportunity to see the direct impacts of blockchain to SupplyChainCo to the business processes. As a leader committed to innovation and process agility, the project created a small ecosystem to examine business processes. Industry-leading consultants were brought in to offer an independent perspective. (5, Senior Director)

Project Trilogy enabled the management to observe the distributed nature of blockchain, which eliminated the need for freight forwarders to control information centrally. Management's awareness of this barrier in conjunction with an organizational commitment to innovation created the external force that challenged organizational inertia. Mitigating the barriers to organizational learning increased the ability to implement all the capabilities of the blockchain technology and consequently reduced the need for intermediaries.

Synopsis – Intermediaries in Innovation

The blockchain technology disrupts the nature of business functions within organizations by removing the need for traditional intermediaries. In the supply chain industry, the assumption used to be that trust is achieved via intermediaries, such as freight forwarders. In SupplyChainCo, the introduction of blockchain obviated the need for such intermediaries because of the digital trust created by the technology.

In the context of organizational inertia, pressure is applied to preserve current business processes and professional relationships. SupplyChainCo achieved organizational learning when the barriers to organizational inertia were overcome through the organizational commitment to innovation and the adoption of a dynamic business process.

V.9 Disruptive Funding Decisions – Learning Case 2

As a DDI, blockchain technology is characterized as pervasive and radical. Hence, there is little precedence that can be drawn on to predict the future impact on the organization. These characteristics caused conflict in the existing funding process, which relies on estimated return on investment and is often based on the returns achieved in similar projects in the organization.

> *In order for SupplyChainCo to be responsive in support of innovation, the funding process must be dynamic and ready to seize the opportunity when it arises. (7, Director)*

Project Trilogy sought to secure funding for the DDI implementation. However, there were three major economic challenges that had to be overcome to secure the funding: 1) the lack of precedence in the organization; 2) the gap in the knowledge of the decision makers; 3) the financial impact on existing funding initiatives.

> *For a shift to use new technologies, like blockchain, to occur, it is not enough for the leadership team to discuss the importance of innovation. The funding process should align to provide innovation projects a fighting chance of getting approval. (9, Manager)*

The financial challenges faced by SupplyChainCo to secure funding are inherent in large organizations.

> *SupplyChainCo as a large organization inherently requires financial structures, rules, and processes. However, we may be inadvertently stifling innovation if we do not align our processes to support our strategic commitment to innovation. (4, Director)*

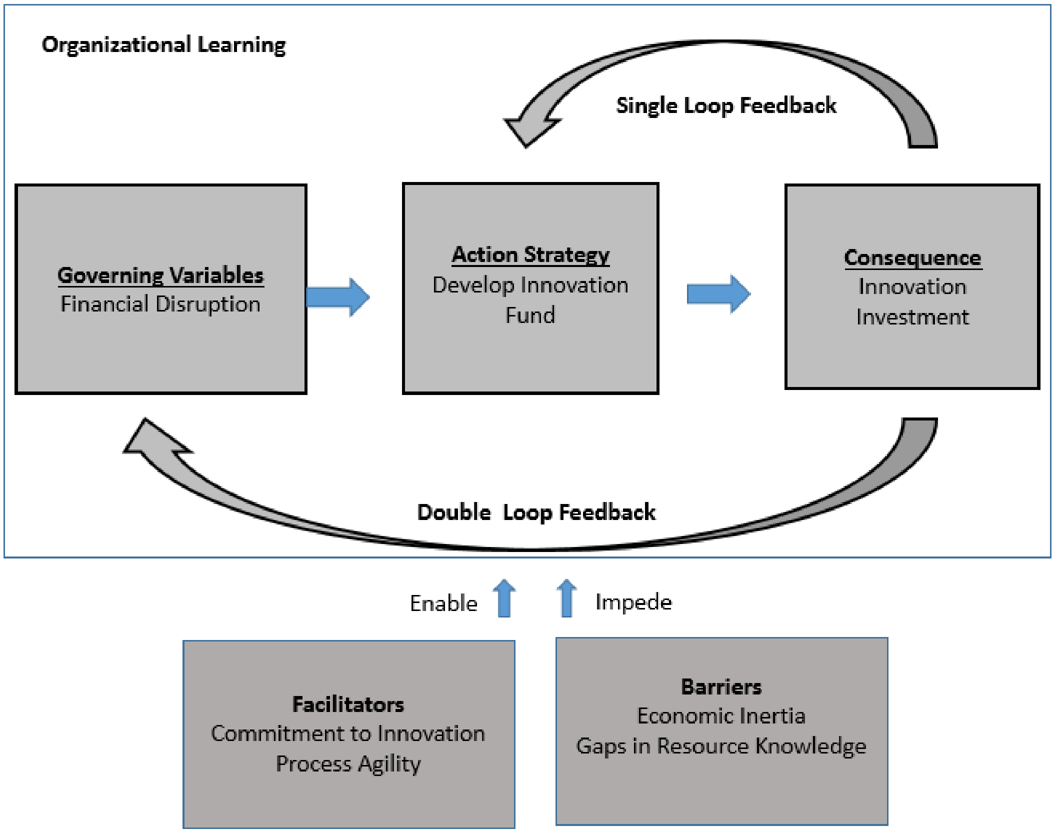


Figure 9.Disruptive Funding Decisions-enabled Organizational Learning

V.10 Governing Variable – Funding Model Disruption

The existing funding process required that the scope was well-defined at the beginning of the project, including the cost of the project and its completion date. However, because the project stakeholders had little understanding of the capabilities of blockchain at the outset by, it was difficult to define the scope and the schedule of the project. This lack of knowledge led to the first of three economic challenges that SupplyChainCo had to overcome to generate momentum and obtain approval for Project Trilogy.

First, SupplyChainCo's approach to funding IT projects was often *"based on well-defined scope. However, with the number of unknowns with this innovation project, the scoped changed rapidly throughout the project's lifecycle" (Engineer, 12).* In addition, *"blockchain as* *an innovation project adds the risks of being an unknown technology with little known return on investment which destined its funding request for denial without leadership intervention" (15, Project Leader).*

The second challenge stemmed from the fact that Project Trilogy opened opportunities that leaders across the organization had not yet recognized. The gap in the leaders' knowledge often creates a barrier to securing DDI funding.

> *With organizational awareness being low, the team had to include educational components to make awareness and to invalidate myths associated with the blockchain. The efforts detracted from the main objective of securing funding. (11, Engineer)*

To mitigate this obstacle, *"the funding request amount must be low until the full capability of the technology can be justified" (16, Engineer).*

The low estimated cost of the project was submitted in the attempt to avoid a complex funding approval process. Experience had taught the team that low requests could go "under the radar" to allow the further development of technical capability and the leadership teams' understanding of the technology.

The third economic challenge arose from the fact that in justifying the investment in a new technology, such as blockchain, its application must be deemed appropriate for multiple use cases. In practice, the identification of multiple use cases placed conflicting demands on funding. The organization had fixed financial resources so new technology was viewed as a financial threat to the existing funded initiatives within the organization, which was less likely to fund the new innovation. For this reason, the manager of Project Trilogy had to select a blockchain use business case that would align with varying leadership motives and intentions to mobilize financial support. The SupplyChainCo's leadership was strategically aligned in reducing COMAT shipping costs.

> *The COMAT use case was selected since the leadership team already had the immediate focus to reduce the cost of shipping company material. The use case also created limited exposure since SupplyChainCo acted as the shipper and carrier of reducing cost. (9, Manager)*

Defining the business case. The immediate business problem was outlined in SupplyChainCo's 2018 business plan. The business plan succinctly addressed the need to focus on innovation to reduce the annual costs of shipping company materials. The supply chain blockchain solution focused on the handling of the movement of company material to support business-to-business operations. The shipping of COMAT typically cost SupplyChainCo $180–185 million per year. However, in the immediately previous year, the cost of COMAT ballooned, representing an increase of 14.5%. In response to the drastic rise in the operational expenses relating to shipping COMAT, the organization studied the technical capabilities of blockchain technology to reduce costs. As a result of this study, the senior leadership group (SLG) approved the project.

Because the supply chain industry is extremely competitive, organizations actively pursue ways to reduce costs to remain competitive. The blockchain technology enables the transformation of the functional services that the supply chain industry provides.

> *We're in a dynamic time in the supply chain industry right now with the emergence of several disruptive technologies. We want to be at the forefront, along with our customers, in leveraging these technologies to bring new efficiencies and solutions to their businesses. (3, Vice President)*

Organizational inertia, particularly economic inertia, impacted SupplyChainCo's ability to receive funding for the blockchain implementation. Management had to recognize the pitfalls involved in applying existing funding methods to DDI projects.

[SupplyChainCo's] funding process was well suited for the typical projects that extend current capabilities. However, the existing funding process was not well suited to handle the injection of such an unknown technology such as blockchain. (Manager, 8)

1. Moreover, economic inertia reinforced the process by which projects were selected to receive funding. Single-loop learning resulted in the refinement of the process, such as the use of return on investment (ROI) in the evaluation of funding projects. Hence, double-loop learning was required to examine the differences that the DDI introduced and to resist using existing criteria in funding approval.

2. The SLT's team desire to fund Project Trilogy was in conflict with the standard funding process. The conflict was resolved when we resisted the existing funding process in acknowledgment that it was not applicable to evaluate DDI efforts such as Project Trilogy. (7, Director)

3. Economic inertia reinforces financial processes and represents the forces that perpetuate the funding of existing business processes. In this study, it was observed that economic inertia stemmed from organizational actors that were embedded in existing business processes.

4. We operate in a cyclical operation where line items in the budget are approved annually with little discussion. This economic practice of partnering with the same business partners aligns with our customer's expectation of predictability. They come to depend on the same operational partners on a yearly basis. (8, Sales Manager)

If the existing funding process had been utilized, Project Trilogy would not have been approved. In a financial approval process where DDI does not exist, the project data are applied to an existing template to help predict the financial investment and potential risk involved in approving the effort. The decision to fund an IT project is based on several factors, such as hardware and software investments, internal human resources, estimated timeline, and consulting services. Such data promote a high level of confidence in the incremental nature of the project enhancement.

> *5. Estimating project data for Project Trilogy was extremely difficult due to a number of unknowns. The team had never developed a project using this technology so past experience could not be used. (12, Engineer)*

SupplyChainCo's successful implementation of the change in the funding process was enabled by the leadership's commitment to innovation, which was demonstrated in the adoption of process agility to address conflicts arising in the evaluation of DDI projects. One example of process change is the requirement of a well-defined scope.

> *With the dynamic nature of the technical and the need for a well-defined scope had to be negotiated. To mitigate the risk of not having a clear scope, project funding was distributed in small increments with a fixed 6-week development timeline. (Manager, 9)*

The scope included a fixed completion date, which limited the organization's financial exposure.

Management's awareness of the CEO's support of the effort further encouraged the process change. Prior to the approval of Project Trilogy, the CEO of the organization shared, *"SupplyChainCo is actively exploring enterprise blockchain applications to improve* our service, *reliability, and costs."*

Senior leadership’s vocalization of their support of Project Trilogy was key in gaining approval for the project despite the existing funding guidelines. The team stressed that the characteristics of blockchain would positively affect the organization’s finances if the economic inertia could be overcome.

6. *While the technology makes the cost savings possible, the cost saving can only be realized if we, the leadership team, make different decisions. The [BCP] provided the required evidence of the economic impact of blockchain. (5, IT Manager)*

7. As part of a larger effort, the management team partnered with the finance department to create an innovation fund within the organization. The innovation fund was aligned with the strategic goal, and it created a funding process that was aligned with the need to deliver innovation quickly. The innovation funding process placed less importance on precedence within the organization and allowed external use cases to be used to derive expected ROI values. The process also allowed innovation projects to compete against other innovation projects to eliminate the need for competing with organizational units that were in fear of being displaced by the innovation. Lastly, the approval board for innovation projects consisted of a small group of persons who were focused on innovation, thus closing the knowledge gap that existed in the organizational funding board. Hence, the governing values overcame the economic inertia. Furthermore, the innovation funding altered the organizational processes and imposed distinct economic measures that were aligned with innovation in SupplyChainCo to overcome the economic inertia.

V.11 Synopsis – Disruptive Funding Decisions

In making funding decisions, the assumption used to be that decisions were based on estimated ROI based on the returns achieved in similar projects within the organization. The introduction of blockchain broke that assumption so that future funding decisions were grounded in a completely new set of assumptions, namely the use of the innovation fund. DDI projects disrupt traditional funding models, but economic inertia preserves current funding practices. In SupplyChainCo, the management's commitment to innovation was extended to include the willingness to modify the funding selection process. SupplyChainCo's leadership collaboratively developed a funding process that was suitable for DDI projects. Therefore, the economic inertia was overcome by the leadership's commitment to create an innovation fund. The process of creating an innovation was made possible by the organization's process agility.

V.12 Technical Response to Blockchain Development – Learning Case 3

New disruptive technology requires the adoption of new processes of collaboration and information sharing. Moreover, the development process requires assistance from people outside the organization.

> *Blockchain inherently will drive process changes, which are difficult but must occur to make blockchain initiatives successful. (13, Principal Engineer)*

At the outset, the technical working guides provided information about vocabulary and terms across all organizations. For example, the technical working guides defined an organization as an entity that needs to maintain a copy of a blockchain ledger and perform transaction validation against blockchain data.

At the conclusion of the eight-week development cycle, competency was successfully demonstrated in the creation of visibility through the asset tracking and performance transparency of the process across multiple organizations. The blockchain distributed the verified information to all members of the blockchain.

> *That is what has been so impressive about the Project Trilogy partnership. We were unintimidated by the complexities of blockchain. We collaborated, shared data and problem solved in nimble fashion. It's going to be this process that enables the next generation supply chain. (4, Managing Director)*

The purpose of Project Trilogy was to implement a permissioned blockchain solution that had broad and long-term implications for disrupting the way the organization handled materials movement in the supply chain and business-to-business operations. Through the implementation of a shared blockchain, SupplyChainCo converged on the feasibility of data sharing among three independent organizations.

The DDI blockchain enabled the creation of a peer-to-peer network. As members of the network, three independent organizations constructed the network and executed specific work tasks, which included the development of the process flow, the composition of work products, and the integration of the work products. Because blockchain was a DDI and a new technology in the three organizations, the peer-to-peer development process differed dramatically from the traditional development process. This deviation was due to the foundational characteristics of the blockchain technology, the new knowledge that had to be acquired, and the communication channels that had to be opened for the development of the peer-to-peer network.

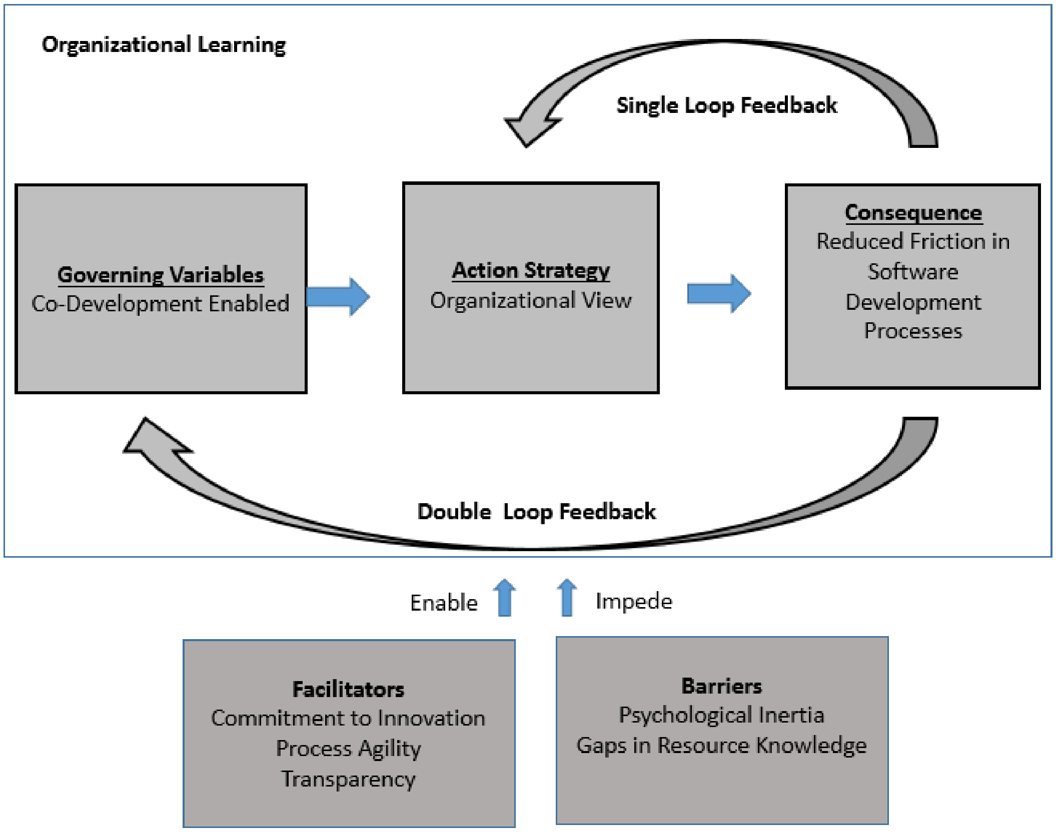


Figure 10. Technical Response-enabled Organizational Learning

V.13 Governing Variable – Transparency

The implementation of blockchain required business process transformation and advances in technical capabilities as well as new infrastructure that extended beyond the organizational boundaries. Transparency, which is a basic characteristic of blockchain, conflicted with traditional software development processes. The transparency and consensus-based validation inherent in the blockchain technology required collaborative development (i.e. co-development) by each peer organization to ensure the distribution of data on the blockchain network.

Because of the characteristics of the blockchain technology, the process of SD was disrupted. The technical knowledge necessary to develop a disruptive innovation solution transcended the borders of BCS, BCL, and SupplyChainCo. Developing a peer-to-peer solution was new in each organization.

> *Project Trilogy provided a learning opportunity for all organization. Originally this was difficult since each organization within the network had its own organization standard for software development. (12, Engineer)*

Another barrier to organizational learning was that the existing IT resources did not include the technical skills required to develop a blockchain solution. Senior technical resource personnel emphasized their concern regarding the team's lack of technical capability and the required technical skill set.

> *The gap in technical expertise was addressed with the hiring of technical consultants. The consultants were also innovative and not constrained by organizational norms, as they were unaware. As a result, they appropriately challenged system development process. (13, Principal Engineer).*

In organizations, psychological inertia is demonstrated in the reluctance to change cognitive structures and interpretations. The adoption of the new technical skills required changes in cognitive structures. Consequently, the productivity was initially stalled because of the gaps in the knowledge of the teams' technical members regarding the development of a blockchain solution.

> *We came to the project effort with varying degrees of technical experience in developing blockchain solutions. We created a technical working guide that became instrumental to the success of the project. As our IT manager stated, "blockchain is a team sport." (12, Engineer)*

To close the disparate gaps in the knowledge, technical working guides were developed to provide consistency in development patterns and shared services. The technical working guides were then distributed to all team members via a shared portal.

> *Typically, we would not openly share technical guides with our business partner. Our technical IP has always been of high importance. However, the technology industry is changing with the use of open-source technology. Open-source development pattern is similar to Project Trilogy - the project solution is developed by multiple people collaborating and distributing the learnings to all members of the network. (16, Solution Engineer)*

In SupplyChainCo, psychological inertia also created a barrier to the open sharing of technical assets across organizational boundaries for two reasons. First, team members were motivated to protect their knowledge and skills, which are highly valued in the organization. The second reason concerns the organizational norm for protecting technical assets. The organizational norms of technical assets with high value had to be addressed by the leadership team.

> *As a member of leadership, we had to shift our position of information sharing. Our current stance on protecting what we had learned was hurting the larger development effort. The negative impact to productivity and partnership with advice from our consultants, change was required. (9, IT Manager)*

Initially, SupplyChainCo made only incremental (i.e. single-loop) changes to the SD process until it impeded the team’s ability to produce software. For example, one interviewee said, *“increasing the meeting frequency to define the technical decisions was not an effective response to ensuring successful collaboration” (Engineer, 12).*

One of the first major technical deliverables was to define how the peer organizations would apply the interface between systems.

Originally, the BCP was designed so *"that each organization would develop independent technical assets that align with the interface contract. However, this expectation had to be revised since the peer organizations did not have the capability to independently develop the chain code structure required for interfacing" (Engineer, 12).*

In recognition of the capability limitation, the leadership was faced with requests by the team to share the technical assets across organizational boundaries. Unfortunately, the existing organizational policies were too rigid to allow the sharing of information with other members of the blockchain network. The blockchain implementation resulted in a complex network of interdependencies that needed to cross boundaries to innovate collaboratively.

> *This blockchain effort moved beyond the development of compatible interfaces and mere co-design in the development of the peer-to-peer network. (Manager, 9)*

Transparency in the co-development was facilitated by the leaders taking an organizational view of the SD process and of the characteristics of the blockchain, which shifted the organizational governing values: *"The organization perspective viewed the peer-to-peer network has as a shared platform" (9, IT Manager).*

Based on this perspective, the co-development efforts and the need for transparency shifted the relationship from peer organizations on the blockchain network to networks of organizations who were also developing peer-to-peer networks. All members with access to the data and shared knowledge enabled co-development for the creation of the blockchain P2P network. With the shared knowledge, the team was able to analyze and optimize business and technical processes.

At the onset of Project Trilogy, the project lacked standards for developing interoperable products across multiple organizations. However, as organizations became knowledgeable about the various working roles and technical techniques, best practices were established and communicated. (12, Engineer)

As an added benefit, the co-development reduced the cost, time, and risks to each peer organization. Moreover, the co-development required BCL, BCS, and SupplyChainCo to work together to create an integrated platform. While the managers' economic motive for reducing liability was high because the projected value of the innovation was difficult to quantify, facilitating co-development reduced the organization's liability by sharing the risks and costs with the partnering organizations.

V.14 Synopsis – Technical Response to Blockchain Development

Digital innovations such as blockchain have disrupted how SupplyChainCo develops software solutions. The findings of the present study showed that blockchain's inherent transparency challenged leadership's position on sharing digital assets and collaboration. Transparency also disrupted the traditional focus on learning being shared only within the organization. The assumption used to be that organization were motivated to protect their knowledge and skills. However, the introduction of blockchain broke that assumption because the transparency and consensus-based validation inherent in the blockchain technology required a collaborative knowledge-sharing development process.

SupplyChainCo was able to build a peer-to-peer network by overcoming psychological inertia, thus enabling co-development that went beyond building compatible interfaces. The benefits of improving the software development process extended beyond those that could be achieved by a single organization. In co-development, multiple stakeholders shared the benefits by modifying the software development process. The improvements in the process could have a long-term impact on each organization involved in the co-development.

Table 9. Summary of Disruptive Digital Innovation Learning Cases

Disruptive Digital Innovation Learning Cases Summary			
Learning Case	Characteristics	Learning Case	Inertia
Learning Case 1 Intermediaries in Innovation	Governing Variable: Immutability Innovation: Base Technology Innovation	In a supply chain, trust is typically achieved via intermediary companies. Blockchain obviated the need for such intermediaries because of the digital trust created through immutability.	**Political Inertia:** Pressure is applied to preserve current business processes and professional relationships.
Learning Case 2 Disruptive Funding Cycle	Governing Variable: Funding Model Disruption Innovation: System Development (SD) Innovation	The introduction of blockchain disrupted the existing funding model, which was well suited to support incremental (single-loop) IT enhancements.	**Economic Inertia:** The introduction of blockchain disrupted the existing funding model. DDI projects disrupt traditional funding models, but economic inertia preserves current funding practices.
Learning Case 3 Technical Response to Blockchain Development	Governing Variable: Transparency Innovation: Services Innovation	Built a peer-to-peer network by overcoming psychological inertia, thus enabling co-development. In co-development, multiple stakeholders shared the benefits by modifying the software development process.	**Psychological Inertia:** Blockchain disrupted how SupplyChainCo developed software solutions and required the adoption of new processes for collaboration and information sharing.

V.15 Learning Case Summary – Blockchain-enabled Organizational Learning

As shown in the summary of the learning cases provided in Table 9, SupplyChainCo strived to facilitate an environment that would support continuous learning. However, the company was faced with multiple challenges in achieving organizational learning during the implementation of the DDI blockchain. Without an organizational perspective, management placed too much focus on technological designs and economic imperatives, thus disregarding important psychological, economic, and socio-cognitive effects as well as the socio-technical and political aspects that lead to organizational inertia. In response to the challenges of organizational inertia, the management of SupplyChainCo, in conjunction with business and technical consultants, created an external force by including an independent perspective, which was used to challenge this barrier.

VI CHAPTER VI – DISCUSSION

This study addressed the research question, "How does managing disruptive digital innovations implicate organizational learning?" by developing a framework (see Figure 7) that represents how DDI is enabled by facilitators and impeded by barriers.

The findings of this study contribute to the literature on organizational learning, organizational inertia, and DDI. This study also explored the interplay between the fields of organizational studies, particularly organizational learning, and disruption in IT. The extant literature rarely considers the role of organizational learning when DDI is implemented in an IT organization. Similarly, the role of organizational inertia in organizational learning had not been addressed in previous studies. The research framework developed in the present study addresses both limitations in the literature in addition to identifying the facilitators of and barriers to organizational learning.

VI.1 Contributions to Organizational Learning

Orlikowski (2001) suggested that organizational changes cannot be understood without considering technological changes, such as DDIs, and that the organizational context shapes how an organization learns. The practical implication of deploying blockchain as a DDI aligns with the theoretical framing of DDI, in which innovations are not singular in nature. DDI normally penetrates an organization through a series of complex, interrelated innovations that impact the business and software development processes. In response to innovation, Argyris (1976) suggested that incremental innovations are focused on leveraging existing designs through minor changes (i.e. single-loop learning). However, some DDIs require a new set of principles, which could redefine the industry (i.e. double-loop learning). IT research continues to benefit considerably from engagements that are focused on system implementation, system impacts, and resource management in particular contexts, such as blockchain (Orlikowski & Barley, 2001). This research extended this focus to include insights gained in organizational learning, thereby developing a fundamental understanding of how organizations should respond to DDI despite organizational inertia.

The research findings confirmed that double-loop learning is extremely rare and difficult to achieve. However, double-loop learning facilitates the organization's ability to embrace disruptive innovation through managerial actions that overcome organizational inertia. According to Godkin and Allcorn (2019), double-loop learning acts as a promoter of disruptive change. The findings of our study will help in understanding the ways in which managers trigger the changes that enable organizational learning, which is essential for the successful embedding of a DDI.

This study extends the extant literature on organizational learning by presenting a novel set of conditions under which organizations can be successful in organizational learning. Although prior research has examined the relationship between innovation and organizational learning (Flores, Zheng, Rau, & Thomas, 2012), this study is one of the first to investigate how organizational learning may be enabled by disruptive digital innovations. The findings of our study suggest enabling the conditions that make it feasible for organizations to reexamine the governing variables that underlie current business processes and strategies. The disruptive technologies present viable alternative paths to achieving organizational goals that may be superior to the status quo. This was manifested in the three learning cases in SupplyChainCo. The first learning case illustrated the reevaluation of and redesign of inter-organizational alliances that were facilitated by blockchain technology. The second learning case illustrated how well-established organizational policies for funding projects were changed significantly to accommodate innovative initiatives enabled by blockchain technology. The third learning case illustrated how co-development and co-creation were superior to maintaining strict boundaries between organizations that participate in the development of an innovative application. Thus, this research provided additional insights into the mechanism through which double-loop learning may be facilitated by the introduction of disruptive technologies such as blockchain. A secondary contribution of our research is that it presents a compelling example of how double-loop learning, which is rarely achieved in organizations, may be enabled by disruptive technologies such as blockchain. It does so by enabling the stakeholders to question long-held assumptions about how organizational activities may be conducted.

VI.2 Contributions to Organizational Inertia

Besson (2012) suggested that inertia itself does not prevent organizations from managing disruptive innovation, but combined with inadequate responses by the leadership, it prevents the success of a project. Overcoming organizational inertia by enabling organizational learning is typically achieved by an outside force (Liao et al., 2008). Business and technical consultants create an external force by offering independent perspectives that could be used to challenge organizational inertia. In the present study, independent external perspectives, in conjunction with managerial support, were found to overcome organizational inertia.

The findings of this study demonstrate that organizational learning is hindered by the effects of organizational inertia. The data analysis revealed specific learning cases in which organizational inertia created a barrier to organizational learning. While prior studies established how IT implementation in organizations may be impeded by organizational inertia (Besson, 2012; Amiripour, 2017; Godkin, 2019), our study is the first to examine the role of organizational inertia in the context of implementing a disruptive digital innovation. While prior research has examined the difficulties involved in overcoming organizational inertia, our research was focused on the potentially significant impacts of digital innovations, which are enabled by its unique characteristics (Kshetri, 2018) and make it possible for organizational actors to overcome inertia. Consider, for example, the ability facilitated by blockchain to dramatically redesign existing business relationships (e.g. with the freight forwarders) without incurring any significant loss of the benefits offered by such relationships and in fact improving outcomes. This enabled the organization to overcome economic and political inertia. Similarly, psychological inertia was overcome by the need to collaborate due to the lack of blockchain experience held by one individual or organization. The competence required to support disruptive innovation cut across organizational boundaries (Van de Ven, 2005), shifting managerial perspectives on sharing information with external organizations.

VI.3 Contributions to Disruptive Digital Innovation

This research contributes to the literature on DDI by examining the unique characteristics of blockchain technology, such as immutability, decentralization, and transparency, which enable organizational learning. This research also contributes to our understanding of how DDI can help dramatically transform core business processes, such as SCM. Organizational transformation that results from organizational learning derives from the emergence of new technological infrastructures and entails the rise of new forms of organizing and maintaining boundaries between fields that specialize in technology and organizational learning (Orlikowski & Barley, 2001). Innovation works best when there is an organizational commitment to innovation and process agility is embraced. Changes in business and technical processes may be required in order to implement a DDI in an organization. The findings of our study suggest that leaders must shift their definitions of success when new disruptive technologies are introduced. The criteria for the successful implementation of a DDI cannot be dependent on existing strategies, as they are doomed to fall into the trap of organizational inertia. Moreover, innovation is not optimized when people use existing procedures and apply past experiences that are not applicable in the present (Stata & Almond, 1989).

VI.4 Double Loop Learning Perspective on Disruptive Digital Innovation

This research offers a theoretical perspective regarding the implications of double-loop learning in the context of DDI. Based on the results of the empirical investigations performed in this study, we propose a new theoretical perspective on how to manage DDIs. As shown in Figure 8, this perspective focuses on the structures that emerge in practice, which aid in facilitating and hindering the embracement of disruptive innovation.

Specifically, SupplyChainCo's blockchain-enabled organizational learning framework synthesized the links between the managerial actions that were executed to impact the organization's ability to deploy a blockchain. The double-loop learning perspective on disruptive digital innovation extends the extant literature by identifying managerial actions that can be deployed within technological organizations. Furthermore, the recognition of how double loop learning implicates disruptive digital innovation offers new insights into organizational learning theory and practice. This study is among the first to examine the role of organizational inertia in impeding organizational learning. It identifies relevant risks and novel ways of managing the risks associated with the implementation of DDI.

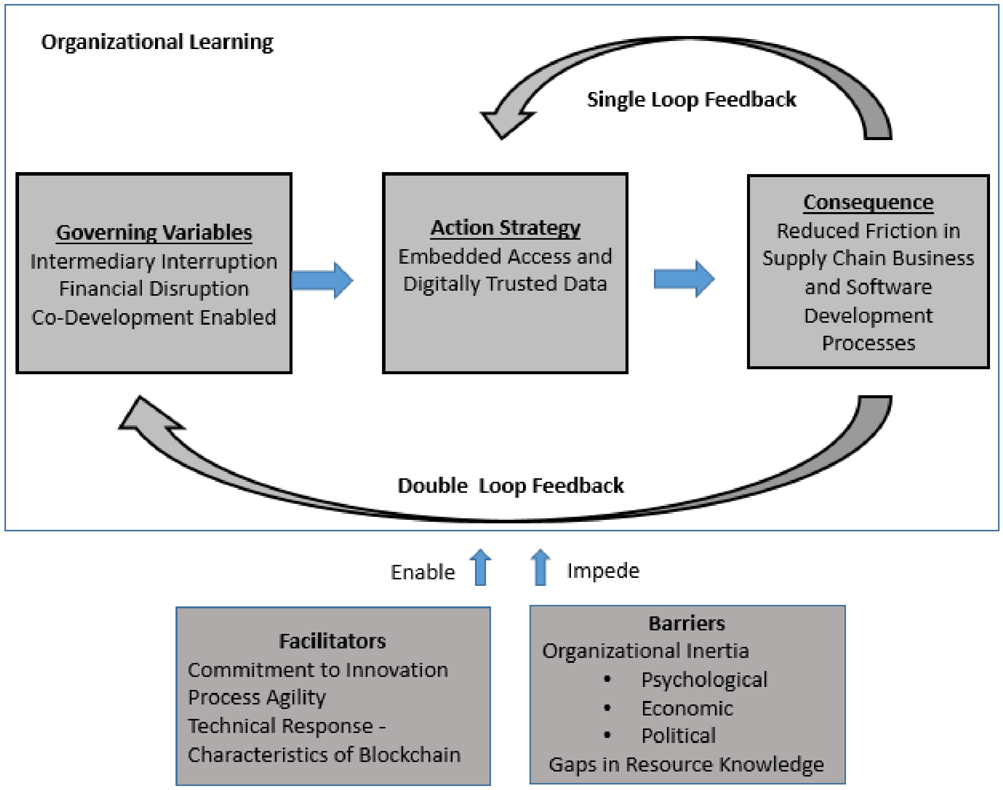


Figure 11. SupplyChainCo's blockchain-enabled Organizational Learning

VI.5 Implications for Practice

The ability of an IT organization to learn can foster the ability to embrace DDIs such as blockchain technology. This innovative technology has the potential to disrupt the industry because of its inherent characteristics of transparency and consensus-based validation. The business implications of blockchain include the opportunities to save time, to improve business processes, and to eliminate processing and data redundancy. Processing efficiency and the elimination of data redundancy are achieved through a distributed or shared ledger. The transparency of the data on the network also enables greater trust in the accuracy of the data on the blockchain. The blockchain technology uses the highest level of encryption, including digital fingerprints, to prevent the modification of existing information in the digital ledger. Blockchain helps eliminate much of the redundancy in the manual processes that are in current use, which require each organization to reconcile independent ledgers. Above all, blockchain technology provides the opportunity to reduce the processes and costs of the supply chain network.

1. *Establish practices to address organizational inertia:* Leaders should perform an organizational evaluation to determine the form of inertia that is likely to hinder learning within the organization. When the form of organizational inertia is determined, leaders should adapt their action strategies to align with the desired consequences. It is also important for project teams to be aware of the impact of organizational inertia in implementing DDI projects. Individual team members should self-evaluate their individual action strategies to ensure their alignment with the desired outcome. While there is pressure to preserve existing business processes and professional relationships, the disruptive characteristics of blockchain - immutability, decentralization, and transparency, transform current processes. Learning to address organizational inertia invokes blockchain's business implication to improve business processes.
2. *Provide leadership to actively facilitate organizational learning:* The leadership should carefully consider any adverse effects that may inhibit organizational learning. Double-loop learning may challenge the underlying norms, policies, and objectives held by the leaders, and in turn require the development of appropriate action strategies. Specifically, as transparency and consensus-based validation are characteristics of blockchain, organizational learning enables transparency for information sharing. Leaders should create strategies to foster double-loop learning and create an environment where diverse viewpoints are welcomed, especially when they conflict with the leader's views.

3. *Increase speed to market for innovation*. Leaders have always had the challenge of balancing the investments in exploratory innovation against investments in exploiting the core business function. Because of the rapid rate of technological change, we may be at the dawn of a new era marked by increasing the speed to market for new innovations such as blockchain. While blockchain has promised to reduce transaction cost, most organizations have limited experience with delivering production scale blockchain implementations. Due to the limited experience in delivering production implementation coupled with the high economic and business expectations creates digital disruption within the organization. To validate the expected value, organizations have explored proof of concepts efforts. Proof of concepts are limited to help to understand the economic return on investing into a disruptive technology.

In SupplyChainCo, the introduction of blockchain technology required the reevaluation of supply chain operations. The impact of the technology implementation resulted in significant disruptions in the operational and financial processes. The long-term implications may include business processes that could be in place for decades, such as financial auditing. Organizations cannot deploy existing managerial and operational procedures based on past experiences that are no longer valid with the use of blockchain technology. In addition, in response to the ever-increasing rate of technological change, SupplyChainCo has challenged the need for investing in multiple POCs, which has intensified the organization's ability to learn and increased the speed at which economic value is realized from their investments in innovation.

VI.6 Limitations

The limitations of this study are related to concerns about bias, generalization, and the theoretical framework. Therefore, caution should be used in generalizing the study's findings to other population samples and settings.

One limitation of the study is the potential for recall bias, which is the result of interviews, events, and data collections that occurred in the past. However, the triangulation of data from multiple sources was used to mitigate this bias. In addition, because the researcher was also a participant during Project Trilogy, there was the potential for authority bias. However, this bias was mitigated by the participation of the second researcher. Moreover, the semi-structured interview protocol required that the participants provide detailed rationales for their responses.

Hindsight bias is a limitation when the project participants contribute a higher quality of work because of the increased involvement of a manager (Pfeffer, Cialdini, Hanna, & Knopoff, 1998). As a participant researcher, the author of the present study was assigned a leadership role in Project Trilogy. Hence, the success expressed by the interviewees may have been influenced by the researcher's supervisory involvement. This potential bias was mitigated by interviewing team members across multiple organizations in a wide variety of roles and responsibilities.

This research was focused on the single case study of an IT organization that supports SCM. Therefore, the application of the findings to different settings, such as IT organizations that differ in location, size, business domain, and organizational structure, may require additional research. The limitations of this study should be considered in light of the advantages that it may provide researchers and practitioners who may wish to transfer the findings to other contexts and settings (Devers, 1999). In addition, Myers (2010) and Yin (2009) suggested that the findings from a single case study could be generalized. This research was based on a single case study of a technology organization in the US. However, this focus does not rule out the possibility of generalizing from description to theory (Lee & Baskerville, 2003) by relying on analytical generalization instead of statistical generalization (Yin, 2003). The generalization of this research study's findings should be exercised with caution because they may be specific to the characteristics of blockchain as a DDI and the research setting. Therefore, it is acknowledged that the findings may vary in the context of another organization or in the context of a different DDI. The findings from a single case study are not generalizable to all DDI projects, yet practical recommendations can be based on such findings, which may be applicable to organizational leaders, project management, business and research and development teams in the IT sector. Furthermore, practical suggestions could contribute to the managerial actions taken to facilitate organizational learning as well as the detection and response to organizational inertia during periods of DDI. Lastly, the DDI framework limits the application of this study's empirical results and theoretical contribution by focusing the analyses on specific issues. Nevertheless, the findings could lead to new understandings in the emerging field of DDI.

Despite these limitations, the study's findings may make a significant contribution to understanding how organizational learning helps organizations manage DDI.

VI.7 Future Research

This study provides the foundation for future research. The present research could be extended by conducting a multi-case study that examines how blockchain technology is expected to affect key SCM objectives, such as cost, quality, speed, dependability, risk reduction, sustainability, and flexibility (Kshetri, 2018). In addition, some DDIs, such as blockchain, require collaboration among organizations. Future research could be conducted to study how DDIs implicate inter-organizational learning and the relationships between organizations. Organizational learning is influenced by organizational culture.

Because the implementation of blockchain could disrupt intermediary business partnerships, future research could be conducted to investigate how blockchain technology disrupts identity verification models. This technology also has the potential to change the customer value chain by revamping identity management. The ability to immediately identify and trust could lead to faster operational transactions and organizational savings.

This embedded case study yielded both theoretical and practical knowledge, thus contributing to implementation of DDIs despite organizational inertia. A follow-up study could explore how the dimensions of DDI and organizational inertia (i.e. psychological, socio-cognitive, socio-technical, economic, and political) interact over time by comparing several organizations during periods of DDI.

VI.8 Conclusion

An example of engaged scholarship, this study offers insights into how organizational learning helps IT organizations manage DDI. The blockchain-enabled organizational learning model developed in this study provides a foundation for developing practical strategies for implementing a blockchain solution within a supply chain organization. Because of the rapidly growing role of technology-enabled digital disruptions in transforming industries, the findings of this study contribute to the understanding of how organizational learning can help organizations manage DDI.

VII APPENDICES

VII.1 Project Trilogy Work Plan

1. Blockchain Foundation		
	1.1 Select and engage team members	
		Confirm roles and responsibilities
		Develop and publish Scrum cadence
		Select business owners
		Select development team
		Select IT SMEs
		Select product manager
		Select product owner
		Select QA
		Select Scrum master
	1.2 Define scope and key partners	
		Collaborate on initial joint teaming agreement
		Create project logs: Risks, Issues, Action Items, Assumptions, Decisions
		Define BCP business case
		Define BCP objectives
		Define BCP scope boundaries
		Determine out of scope parameters
		Develop project charter/scoping statement
		Select BCP external partners
		Select BCP internal partners
	1.3 Conduct formal kick-off meeting	
		Conduct external kick off meeting
		Conduct internal kick off meeting - soft launch
		Prepare kick-off deck
		Schedule kick-off meeting
	1.4 Prepare to execute BCP	
		Agreement by external partners
		Agreement by internal partners
		Collect all required inputs
	1.5 Select and install environments	
		Configure pipelines for development and testing
		Install cloud environments
		Obtain environment credentials and access for DEV team
		prepare blockchain conceptual architecture
		prepare blockchain logical architecture
		prepare blockchain physical architecture
		Select cloud environment
		Select code repository
		Select knowledge repository

2. Blockchain Project (BCP)			
	Cargo shipping fulfillment (movement request)		
		Alert confirmed weight is out of compliance	
		Alert initial weight is out of compliance	
		Capture invoice	
		Capture other rules, as necessary	
		Capture shipping guidelines	
		Capture shipping request	
		Capture vendor's contract	
		Confirm weight is in compliance	
		Develop initial UI	
		Integrate to vendor via API	
		Integrate UPS via API	
		Prepare for blockchain MVP	
			Agreement by external partners
			Agreement by internal partners
			Collect all required inputs
		Report confirmed weight is out of compliance	
		Report initial weight is out of compliance	
		Report transaction is out of compliance	
		Signal (alert) transaction is out of compliance	
		Validate initial weight is in compliance	
		Validate shipping request is in compliance	
3. Blockchain MVP			
	Epic 1		
		Epic 1	
		Story_1_Test	
		Story_2_Test	

Appendix B. Inform Consent Form

Informed Consent Form

Georgia State University

Department of J. Mack Robinson College of Business

Informed Consent

Title: How Organizational Learning Facilitates Disruptive Innovation

Principal Investigator: Dr. Balasubramaniam Ramesh

Student Principal Investigator: Veneetia Smith Johnson

I. Purpose:

You are invited to participate in a research study. The purpose of the study is to investigate how organizational learning facilitates disruptive innovation within a large technology company. The study will include how disruptive innovation is managed and a detailed empirical account of blockchain implementation. Thirty participants will be involved in the study. You are invited to be involved in this study because you are an information technology professional who is actively engaged in a blockchain project.

II. Procedures:

If you decide to participate, you will be asked a series of semi-structured interview questions. The interview will be audio-recorded. Handwritten notes will also be taken. The interaction will be limited to me, the Student Principal Investigator (Veneetia Smith Johnson) and you, the Participant. We will conduct the research either in a secluded public location in-person, via instant messaging, or over a recorded conference line. The duration of the interview is estimated to last for one hour. Any personally identifiable information will be removed from the final study results.

III. Risks:

In this study, you will not have any more risks than you would in a normal day of life.

IV. Benefits:

Participation in this study will not benefit you personally. However, overall, we hope to gain insights that will benefit society's comprehensive understanding of managing disruptive innovation.

V. Alternatives:

The alternative to taking part in this study is to not take part in the study.

VI. Voluntary Participation and Withdrawal:

Participation in this research is voluntary. You do not have to be in this study. If you decide to be in the study but change your mind, you have the right to drop out at any time. You may skip questions or stop participating at any time.

VII. Confidentiality:

We will keep your records private to the extent allowed by law. The following people and entities will have access to the information you provide:

- Dr. Balasubramaniam Ramesh, the principal investigator and Veneetia Smith Johnson, the researcher
- GSU Institutional Review Board
- Office for Human Research Protection (OHRP)

We will use Interview Participants' Initials, Date, and Participant's Position rather than your name on the study records. The information you provide will be stored on Microsoft OneDrive. The storage drive has 128-bit encryption to help protect file sharing connections. A key (code sheet) will be used to identify the research participants and so forth. The key will be stored separately from the data to protect privacy.

When we present or publish the results of this study, we will not use your name or other information that may identify you. The audio recording will be stored on OneDrive and will be destroyed two years after the research is published. If the interview is conducted virtually over the Internet, please be aware that data sent over the Internet may not be secure. The IP address will not be collected in this study.

Names or identifying information about participants will not be published in presentations or publications.

VIII. Contact Persons:

Contact Veneetia Smith Johnson at (404) XXX-XXXX and vjohnson34@student.gsu.edu

- if you have questions about the study or your part in it
- if you have questions, concerns, or complaints about the study
- if you think you have been harmed by the study

Contact the GSU Office of Human Research Protections at 404-413-3500 or irb@gsu.edu

- if you have questions about your rights as a research participant
- if you have questions, concerns, or complaints about the research

IX. Copy of Consent Form to Participant: We will give you a copy of this consent form to keep.

If you are willing to volunteer for this research, please continue with the interview.

VII.2 Appendix C. Interview Protocol Excerpt

Interview Protocol Excerpt

Business Unit: ____

Interviewee (Title and Pseudo Name): __________________________________

Interviewer: ____

Survey Section Used:

_____ A: Interview Background

_____ B: Organizational Learning

_____ C: Disruptive Digital Innovation

_____ D: Team Demographics

Other Topics Discussed: ____

____

Documents Obtained: ____

____

____

Post Interview Comments or Leads:

____

Teaching, Learning, and Assessment Interviews

Introductory Protocol

Only researchers on the project will be privy to the recordings so that they can be transcribed. Thank you for agreeing to participate. As a reminder, please do not use names that could identify others during the interview.

A. Interviewee Background

1. How long have you been …?

    _______ in your present position?

    _______ at this institution?

2. Tell us about your professional experience.

B. Organizational Learning

8. How do employees in different areas share experiences and/or knowledge innovation and project delivery?

    Probe: Why do we have crossing sharing/learning experiences?

9. What are the processes for acquiring relevant information about innovation from outside the company?

10. How does the organization avoid reinventing the wheel by seeking relevant information about experiences inside or outside the company? How would you describe the culture of open communication?

11. Are there opportunities for management to assign employees to other parts of the company for cross-learning?

    Probe: If so, how is the process practiced?

12. How does senior management integrate information about new innovation from different organizational areas?

13. How does the organization make relevant changes based on new innovative knowledge?

Probe: How are teams prepared to rethink decisions when presented with new information?

14. How are conflicts effectively resolved when they are generated by different ideas and perspectives?
15. How easy is it to talk with members of this organization regardless of their rank or position?
16. Are you continuously willing to challenge others' thinking during the decision-making process?

Probe: Do you feel that your team challenges your ideas for the advancement of the team?

17. How can the team anticipate and overcome the roadblocks to innovation?
18. What rewards do employees receive from the organization for engaging in innovation?

C. Disruptive Digital Innovation

1. How do you define innovation?

   Probe: Describe innovations that were disruptive to your industry
2. What are the organizational conditions, processes, and structures that encourage innovation?

   Probe: How does the team pilot disruptive digital innovative ideas?
3. What rewards do employees receive from the organization for engaging in innovation?
4. Should the organization change its practices to incorporate disruptive innovations?

   Probe: If so, what practices should change?
5. There is typically a pull that subtly influences new ideas to resemble what the organization has done before. Is there an organizational mechanism that creates an innovation "safe space"?

6. What role do senior executives play in innovation?

D. Demographics

Post Interview Comments and/or Observations:

7. What is the team size?
8. Describe the team demographics by the following:
    - Role
    - Tenure with the company
    - Professional experience

Table 10. Project Trilogy's Definitions of Blockchain Terms

Project Trilogy's Definitions of Blockchain Terms	
Channels	Enables mechanism for privacy and confidentiality for conducting transactions between blockchain organizations
Organizations	Any entity who needs to maintain a copy of the Blockchain ledger and has the ability to validate transactions.
Peer	Node associated with an organization that contains the ledger and performs validates transactions. Peers are associated with an individual blockchain organization
Peer Nodes	Peer maintains a copy of the ledger and the smart contracts. It can act in various roles, including endorser, validator, and committer.
Smart contracts	transaction logic run on the distributed peer network

Table 11. Project Trilogy Sequence of Major Events

Project Trilogy Sequence of Major Events	
Date	Events
Jan-18	Executive Blockchain Proposal and Approval
Feb-18	Determination of Business Use Case
Mar-18	Identification of Resource Gap - Sourcing Request
May-18	Determination of Peer-to-Peer Network
Jun-18	Selection of Blockchain Organizations (BCL & BCS)
Jun-18	Resource Selection Review
Jul-18	Completion of Legal Agreements
Aug-18	Project Trilogy Kick-off Meeting
Aug-18	Finalized Resources Decision
Sep-18	Project Trilogy - Start of Development
Oct-18	Project Trilogy - Executive Demo 1
Oct-18	All Participants Contribute to the Blockchain
Oct-18	Smart Contract Deployment
Oct-18	Project Trilogy - Executive Demo 2
Oct-18	Milestone: Completed User Interfaces, Data Privacy
Nov-18	Executive Presentation
Nov-18	Project Trilogy Retrospective

Table 12. Project Trilogy Collaboration Approach

Project Trilogy Collaboration Approach
4. Alignment of Vision and Objectives
5. Agreement on the Baseline of Current State
6. Identification and Prioritization of Opportunities within the Current State
7. Recommendation of Alternative Solutions

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VITA

Veneetia Smith Johnson is a corporate executive, technology and leadership consultant, executive mentor, entrepreneur, and educator with multiple decades of experience. Johnson brings passion to her career as a technology executive and innovation strategist. Her experience crosses many business domains: airport operations, warehouse management, e-commerce, retail, and HR systems. Of her, it has been said, “Veneetia is enthusiastic and tirelessly evangelizes technology transformation and cultural changes.”

She enjoys helping organizations tackle their toughest business challenges while bringing innovation to develop positively impacting solutions. At the time of writing her dissertation, she was actively leading multiple blockchain initiatives in partnership with several Fortune 500 companies and serving on the Board of Directors for Blockchain in Transportation Alliance (BiTA).

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Outside her profession, she enjoys quality time with her wonderful husband, Landon Johnson, her amazing son and daughter, her family, and her closest friends. She loves playing tennis in local leagues, running, reading, traveling the world for leisure, and doing community service through her sorority Delta Sigma Theta.