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Walden University

College of Management and Technology

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William Collins

has been found to be complete and satisfactory in all respects,
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Walden University
2020

Abstract

Understanding Scaled Agile Framework Coordination Methods for Reducing Failure Rates

by

William Collins

MS, Strayer University, 1999

BS, North Carolina State University, 1980

Proposal Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Management

Walden University

August 2020

Abstract

As organizations' software needs continue to increase, software development failure rates parallel and directly threaten organizations' wellbeing and viability. The purpose of this qualitative exploratory single case study was to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework. The research question was designed to explore how large organizations transforming to scaled agile frameworks use coordination methods to support software and systems engineers to potentially improve the success of implementation. This was an exploratory single case study of a global aerospace organization. Data collected included historical organization documents, casual field observations, and semi-structured interviews with a cross-section of 12 engineers and managers regarding coordination experiences to understand the methods and relationships impacted by coordination. The conceptual framework included von Bertalanffy's general system theory and Malone's coordination theory. Five key themes emerged through thematic analysis of textual data and transcript analysis: effective-efficient performance, knowledge transfer, transformational leadership, cross-boundary, and cognitive diversity. This research identified problem factors, including efficient and effective coordination methods, knowledge transfer, changing mindset, and cultural shift. This study contributes to positive social change for organizations transforming to the scaled agile framework through an enhanced understanding of factors involved with successful implementation, providing psychosocial reinforcement to employees and management while increasing performance that supports an organization's financial objectives.

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Dedication

“No man is an island,

Entire of itself,

Every man is a piece of the continent,

A part of the main.

If a clod be washed away by the sea,

Europe is the less.

As well as if a promontory were.

As well as if a manor of thy friend's

Or of thine own were:

Any man's death diminishes me,

Because I am involved in mankind,

And therefore never send to know for whom the bell tolls;

It tolls for thee.”

---John Donne

This study is dedicated to my wife, Patricia for the hours of sacrifice, support, incredible patience, and belief in me. For the 54 years she has been the better half of me.

Acknowledgments

John Donne said no one is an island. The completion of a dissertation requires humility of its author and selfless support of many cohorts, faculty, and friends. To properly list all who have supported this journey would double the size of the study. My doctorate has been an endeavor to gain a small increase in knowledge and a large increase in understanding. I hope my grandsons, Benjamin, and Adam, will see education as a means to better understand the world they will live in and a source of fulfillment.

This dissertation could not have been written without Dr. Karla S. Phlypo, who not only served as my Chair, but also encouraged and challenged me during my capstone process. After the death or departure of three previous Chairs, Dr. Phlypo accepted the challenge to create a phoenix from the ashes and has succeeded beyond what was possible. I especially want to thank Dr. Elizabeth H. Thompson, who had the unenviable challenge to replace my original second committee member late in the process and with no notice. I would like to thank, Dr. Walter McCollum, for inviting me into a unique Cohort that created a support environment that works and gets candidates to the finish line. It is necessary to recognize all my fellow Cohort members who added to my success and knowledge throughout the entire process.

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Chapter 1: Introduction to the Study

Increasing technology constraints and socio-cultural barriers force information management systems to become increasingly complex for maintaining and transferring knowledge effectively and sustainably. Software needs in business continue to grow, and software development failure rates directly threaten companies' existence (Liu, 2013). The United States spends more than $250 billion each year on the development of 175,000 software projects at an average cost of $2,322,000, and many of these projects fail. Information technology (IT) successful completion rates are between 30% and 40% (Shahzad, Awan, Lali, & Aslam, 2017).

A scaled agile framework is a social process that evolves from six sigma and lean. Organizations that had traditionally used waterfall processes and worked in cultural silos create high stress during a scaled agile framework transformation. The outcome of a collaboration of software experts in 2001 created a summary of agile values called the Agile Manifesto (Cockburn & Highsmith, 2001). Agile methods challenge IT managers to improve the productivity of development teams. Before agile methods, software development used the traditional waterfall method exclusively. The Agile Manifesto values individuals over tools and processes, working software over documentation, customer collaboration over negotiations, and flexibility over a schedule. Rapidly changing innovations pushed agile methodology to include software and engineering (Knaster & Leffingwell, 2017).

The transition from the traditional waterfall method to agile methods is a major, systematic, organizational transformation. Yet, development managers in the United

States have a knowledge gap on coordination methods required during a systematic organizational transformation, and there is little understanding of how to achieve effective coordination (Amici & Bietti, 2015; Paasivaara & Lassenius, 2016; Strode, Huff, Hope, & Link, 2012). A recognition that coordination is critical to transformation and knowledge of the diverse coordination methods can challenge the assumptions about managing transformation at an organization leading to more successful transformations, which is a positive social change. This chapter includes a description of the problem, purpose, research question, conceptual framework, nature of the study, definitions, assumptions, scope and delimitations, limitations, and significance of the study.

Background of the Study

During the 1960s, computing and programming advanced at an accelerated rate (Wirth, 2008). Many new ideas were not evaluated because the software engineering field was moving at such a rapid pace. In 1968, there was a software engineering conference in NATO. The term programming used through the mid-60s changed because of the 1968 NATO meeting (Wirth, 2008). The term software crisis also coined at the NATO conference. The software crisis was due to the rapid increases in computer power and the complexity of the problems that rendered existing methods, neither enough nor efficient (Dijkstra, n.d., 1978).

Between 1970 and 1990, improvements in computing power had outpaced the programmers' ability to use those capabilities (Wirth, 2008). Various processes and methodologies were developed between 1970 and 1990 to resolve the software crisis. However, software projects that were large, complicated, poorly specified, and involved

unfamiliar aspects were vulnerable to significant, unanticipated problems (Wirth, 2008). In the 1990s, the open-source phenomenon grew (Wirth, 2008). In 2001, a substantial shift in focus emerged.

The waterfall method was a sequential process that documented the software development effort (Cockburn & Highsmith, 2001; Glaiel, Moulton, & Madnick, 2014). Rapid prototyping created an iterative approach to build, show the customer, and rebuild based on feedback. The spiral method delivered a series of prototypes incorporating changing requirements.

Incremented delivery methods delivered the system in functional segments and integrated incrementally to create the complete system. The evolutionary delivery method used an iterative approach, part rapid prototyping, and part incremented delivery, which allowed customers to test increments of the software (Charette, 2005; Fry & Greene, 2007; Maples, 2009). The evolution continued, and the evolving development methodology continued to try to keep pace with changing technology. Disruptive technologies changed with more significant acceleration and left some of the largest organizations behind as newer competitors emerged (Wirth, 2008).

Frustrations with the high overhead and sequential obstructions of the waterfall method and long lead times required a change in methodology. In February 2001, 17 people met at a ski lodge in Utah to restore credibility to the software development process (Fowler & Highsmith, 2001). The resulting concept was known as the Agile Manifesto. Agile is an understanding that people have different skills and personalities, and the people, environment, and culture interact to create the organization (Cockburn &

Highsmith, 2001). The Agile Manifesto sought to improve software development through the implementation of a carefully articulated set of principles. Fowler and Highsmith (2001) identified the core agile values as “individuals and interactions over processes and tools; working software over comprehensive documentation; customer collaboration over contract negotiation; and responding to change over following a plan” (p. 29). Agile became a partial solution to the dynamic changes in technology related to people’s issues.

According to Turner, Ingold, Lane, Madachy, and Anderson (2012), a scaled agile framework provided greater capability for scaling agile development across the portfolio, value stream, program, and team levels. The framework was scalable to allow organizations to adopt the change to the business environment. The framework had four core values: (a) Alignment, (b) Built-in Quality, (c) Transparency, and (d) Program Execution. Scaled agile framework evolved from agile principles, lean product development, systems thinking, and observation of successful enterprises.

Yet, despite the creation of agile values, Livschitz (2005) announced that software engineering was in a severe crisis. The technology continued to expand at rapid rates, and incoherent alignment resulted in increased cost and complexity of software development. An unstable environment for software engineers and management of software projects became increasingly tricky (Wirth, 2008).

In 2007, Fry and Greene discussed their transformation to an agile methodology. Fry and Greene’s (2007) case study was a bit unorthodox because it transformed the entire company of 200 employees in a single 3-month effort. The transformation employed some basic tenants of the agile process using cross-functional teams and

creating feedback loops. Fry and Greene prioritized work and applied significant external training before, during, and after the implementation, which follows agile suggestions. The transformation created a “bias to sharing information with everyone” (p. 3). Agile provided a partial solution for small and medium-sized projects, and the size and complexity of software development outpaced the organization structure.

Maples (2009) investigated a post-transformation phenomenon and identified a point where the organization was handling issues outside the scope of agile, where the traditional business offices conflicted with agile, and factions of the organization were in opposing focuses. Employee interpretation of the conflict between the business office and agile resulted in a belief the organization was reverting to business as usual. The dispute put the entire transformation in jeopardy and recognized disruptive events that interrupt the transformation to continue in its evolution could be significant (Maples, 2009).

Vijayasarathy and Turk (2012) investigated the factors that enable and detract from adopting agile practices. Review of prior studies provided training and self-efficacy as ability factors; organizational culture and adaptability to change as factors for motivation; and perception of use and compatibility as innovation factors. Vijayasarathy and Turk found that agile adoption depends on critical people supporting the adoption, and the larger the organization, the more resistance to the approval of agile would occur. Turner et al. (2012) focused on systems engineering and identified several factors common to both the discipline of software engineering and systems engineering, which was significant to the addition of hardware to the scaled processes.

The increasing complexity of software development projects created the need to reorganize structures in the organization and to investigate the methods that would provide coordination in that new environment (Pemsel & Wiewiora, 2013). Organizations found themselves having to leverage the disruption into opportunity by finding ways to adapt to change. That change is directly reliant on developing software and systems and the ability to scale projects using tools like a scaled agile framework introduced in 2011 (Knaster & Leffingwell, 2017).

Strode et al. (2012) identified collaboration, coordination, and communication as critical factors for agile processes' success. Strode and colleagues asked how projects achieve effective coordination. Study findings revealed three mechanisms supporting a successful coordination effort were synchronization, structure, and boundary spanning. The need to become more agile to meet disruptive technologies required flexible methodologies and processes that challenged software developers. Knowledge work, software, and systems engineering all required the means to smooth the workflow and match work with available resources in diverse geographic locations.

Bass (2013) explored offshore projects that required multinational locations. The evolution of complex, large-scale projects made inquiry more critical than in previous years. Bass found new projects attempted to employ the agile principle of colocation. These were small teams that self-organized to adapt to their environment. The large-scale and complex projects were evolving required a change to the organizational structure that satisfied the coordination of the multiple locations involved.

The difficulty of making decisions requires product owners at each site to prioritize their operations to support the more significant project (Bass, 2013). Bass determined that large-scale projects could be scaled to employ agile processes and that the product owner team evolved out of the need to manage in a distributed environment. Gill (2015) examined the adoption of agile principles to large-scale projects. Gill focused on the ability to teach software engineers the discipline. The ability to change the learning environment to large-scale software engineering practices presented significant challenges to educators. Gill realized that coordination and communication were critical to agile software engineering.

Saeeda, Arif, Mehmood Minhas, and Humayun (2015) explored the relationship between lean and agile. Collaboration, coordination, culture, and project size were determined to have a significant impact on large projects. Saeeda et al. concluded that the problem of adapting large scale agile projects research was not available, and there was no confirmed solution to the problem. A new framework was required to address the growing situation and changing to a new structure can cause resistance. Vrhovec (2016) addressed opposition to change and its application to agile transformation. Software process changes and organizational transformations accompanied agile software adaptation and resistance to change, or the inability of corporate culture to change was often the principal reason for failure.

The collective studies of Strode et al. (2012), Turner et al. (2012), Bass (2013), Saeeda et al. (2015), and Vrhovec (2016), have established coordination as a critical factor for the successful transformation to the new development methodology. Strode et

al. (2012) focused on coordination in a transforming environment and endeavored to understand the methods and relationships impacted by coordination during a transformation to a scaled agile framework. Large-scale projects need more coordination, and a systemic view of coordination is missing (Dikert et al., 2016). Amici and Bietti (2015), Dikert et al. (2016), and Strode et al. identified a gap in how projects achieve coordination and a lack of understanding of efficient and effective coordination methods that lead to successful software development. The gap in knowledge of coordination that supports transformation to new methodologies needs a better understanding to achieve successful organizational transformation (Saeeda et al., 2015).

Problem Statement

The social problem is that software development failure rates in the United States continue to be near 70% (Curcio et al., 2018; Daniels & LaMarsh, 2007). Businesses cannot sustain software and engineering projects failure rates this high. Companies' software needs continue to increase, and software development failure rates directly threaten the existence of those companies. Current research into software development has covered the evolution of software development processes but has not provided the knowledge that understands how coordination can help reduce failure rates. The current literature indicates that the traditional waterfall methodology is not working, and the agile methodology has been evolving continuously with some answers for smaller projects but does not scale up to larger and more complex projects needed today.

Many of the current literature articles conclude that coordination is a critical tool for large-scale projects to improve their low success rate. However, what they have not

covered is a description and analysis of specific, practical coordination methods that lead to successful software development. The specific research problem is a gap in knowledge about the coordination that supports transformation to the scaled agile framework, which can reduce failure rates in software development projects. Consequently, organizations, engineers, software developers, and managers are not equipped with the skills and understanding required to implement effective and efficient software development methods, resulting in higher than acceptable failure rates, cost overruns, frustration, and adverse psychosocial disruptions, during transformations.

Purpose of the Study

The purpose of this qualitative, exploratory, single case study was to understand the methods and relationships impacted positively by effective coordination during a transformation to the scaled agile framework. Coordination of disparate functional groups is necessary to synchronize all the entities within the organization to a singular focus on the enterprise goals (Leffingwell et al., 2017). In contrast, silos are an obstacle because the development of large-scale systems is a social activity, and silos represent a barrier to effective coordination.

Research Question

The overarching research question of this study was, how does a large organization use coordination methods to support software and systems engineers to successful transformation to the scaled agile framework? The research question was broken into three subquestions to enable a more specific focus on interview analysis:

Subquestion 1: How is coordination achieved in a scaled agile framework environment?

Subquestion 2: How does coordination increase the successful transformation to a scaled agile framework?

Subquestion 3: How does the coordination process impact interaction among members of the project to reduce failures?

Conceptual Framework

This study was bounded by two concepts that focused on the evolution of systems and coordination: von Bertalanffy's (1969) general system theory and Malone's coordination theory (1988). The attention to large-scale transformation and coordination addressed logical connections between humans in the system, growth of technology, adaptation to evolving systems and organization changes, increased information, and the problems coordinating in this new environment (Amici & Bietti, 2015; Bush, LePine, & Newton, 2017; Butchibabu et al., 2016). A common finding among scholarly research was the identification of coordination as a critical success factor in large-scale organization transformation (Eriksson & Stanton, 2015; Lee, Parker, & Lee, 2015; Strode et al., 2012).

General system theory was developed by von Bertalanffy (1969) that focused on the wholeness of the system. In the system concept, there are interrelationships between the system elements and the environment. As part of the theoretical framework, von Bertalanffy used the concepts of man-in-the-loop, evolution, information, adaptation, and organization to understand the system as a group of independent and interrelated parts

influenced by the environment. The information and system feedback operations in Malone's coordination theory (1988), closely related to communications theory. The feedback mechanisms are a method of coordination.

Malone's coordination theory (1988) was a significant initiative at applying the concepts of technical and human organization. Malone's earlier work focused on modeling coordination efforts in organizations. After this work Malone posited the coordination theory and began to apply coordination theory as a key success factor to improving organizational change. Malone (1987), Malone and Crowston (1994), and Malone et al. (2017) added to this theory by bridging the gap in the literature regarding the relationship between coordination methods and organization changes. Coordination theory explained that many people had acquired direct access to computers. Dramatic improvements in the costs and capabilities in the computer sciences led to a growing recognition that there are common problems within scientific and psychosocial disciplines (Malone, 1988; Malone, & Crowston 1994).

Multiple perspectives fostered new insights and stimulated new theory, where the concepts from one domain would lead to an application in another domain. Abstractions of coordination theory were the critical link to facilitating new connections. Coordination theory works in and contributes to many fields, like the concepts of the general system theory by von Bertalanffy. Amici and Bietti (2015) explained that coordination among humans facilitates collaborative and cooperative behavior; even though little knowledge exists about the exact way coordination, collaboration, and cooperation are linked.

Cross-disciplinary relationships, knowledge transfer, changing mindset, and cultural shift required by organizations transforming to the scaled agile framework addressed the conceptual framework used in this study. The conceptual framework for this study consists of Bertalanffy's general system theory and Malone's coordination theory. Bertalanffy's general system theory provides a means to address the organizational structure and the interrelationships among the structural levels involved in the transformation. Malone's coordination theory provides a man-machine cognitive interdependence.

Nature of the Study

This study employed a qualitative, exploratory, single case study, and this methodology aligned with the purpose of the study which was to understand the methods and relationships impacted positively by effective coordination during a transformation to the scaled agile framework. The research question called for a better understanding of coordination methods, which were identified as part of the literature gap.

The phenomenological approach was rejected because of its focus on the lived experiences of specific people. Ethnographic research was considered because the transformation in the study was related to cultural values and beliefs. Ethnographic studies require the researcher's full immersion into the setting of the group studied and not something that the study could accomplish with the available schedule. A grounded study was not considered because the grounded study requires an existing theory to explain the transformation and the employed coordination methods. Framing the research in system theory and coordination theory allowed a more focused analysis within the

system and the time constraints. Within that conceptual framework of my research, software developers and engineering teams offered a source of in-depth understanding of the situation, which is why the chosen method was the case study method. Simon and Goes (2013) suggested the case study can provide an advantage because it applies to real-life, and deals with a contemporary situation, and involves human behavior.

The use of a qualitative approach and exploratory case study design approach was selected because a qualitative approach can uncover trends in thought and opinions and, in this study, provide a better understanding of how coordination methods are perceived by different team disciplines and offer insight into an improved process (Merriam & Tisdell, 2016). The maturity of the transformation process to a scaled agile framework lacks quantitative measurement and made quantitative research a less valued choice (Strode et al., 2012). The framework of general system theory and coordination theory aligned well with methods such as open-ended questions, emerging approaches, and narratives or graphical data.

A case study was most appropriate to gain an in-depth understanding of the situation and to obtain new knowledge. Merriam and Tisdell (2016) identified a case study as “an in-depth description” in “bounded systems” (p. 37), and Yin (2014) stated that case study research contributes knowledge of individuals, groups, and organizations. Case-based reasoning is a paradigm that suggests a new cognitive model from previous successful experiences. The case study is a blend of psychology and information systems that accommodates engineering concerns with knowledge acquisition (Slade, 1991).

The focus was on participants' views within the real-world context of their work settings. In the context of process and cultural transformation studied in this research, the assumption was that participants comprehend their work environment based on historical and social perspectives. Study participants came from a single project that was transforming into the scaled agile framework. Eligible participants were required to have experience in a minimum of one waterfall development project.

Maxwell (2012) found the strength of qualitative research comes from selecting the right people. The partner organization transformation team identified potential interview participants, explained the study goals, and requested volunteers to contact me directly. Data came through a variety of sources that included observing coordination methods used in an operation area and recording the methods in an observation journal, an interview guide that captured individual interviews on audiotape, and archived data. The participants representing each key position provided interviews.

My cultural and experiential background contained biases and values that had the potential to affect data (Fusch & Ness, 2015). Triangulation enhanced the reliability and mitigated potential bias of results and had a direct link to data saturation (Fusch & Ness, 2015). Hagaman and Wutich (2017) found identification of themes that could occur within 10 interviews. The interviewees for my study intended to start with no fewer than 12 and the addition of increments of two interviews until saturation.

The analysis used the Atlas.ti8 qualitative data analysis software. Saldaña (2016) confirmed that the codes identified by any software program should be reviewed and

analyzed to understand the interview responses. Analysis validity can be enhanced if field notes and historical documents can be reviewed and compared to the software codes.

Definitions

The following definitions are provided to add understanding to this study:

Adhocracies: "Rapidly changing organizations with shifting project teams, often highly decentralized networks of autonomous entrepreneurial groups" (Malone, 1988, p. 13). Electronic media may facilitate people with diverse knowledge and skills needed for these teams.

Agile: Agile software development is a set of iterative and incremental software engineering methods that are advocated based on an *agile philosophy* captured in the Agile Manifesto. The Manifesto repackages previously known good software development practices, and the agile movement became an alternative to traditional software development methods, because agile methods were designed to accept and manage change (Dikert et al., 2016).

Boundary coordinator role: A project team member who supports interaction with people not part of the project team who have needed resources or information (Strode et al., 2012).

Boundary spanning activities: Activities performed by a team or individuals to obtain assistance or information from external units (Strode et al., 2012, p. 1231).

Boundary spanning artifact: An artifact that enables coordination between the team boundaries (Strode et al., 2012).

Collaboration: A process involving various agents that have different perspectives on a problem. The varying agents engage beyond their own expertise and constructively exploring their differences for common solutions. In contrast to cooperation, collaboration involves creating a solution that is based on a collaborative solution, rather than an individual solution (Shah, 2013).

Communication: A process of sending or exchanging information and carrying out collaboration (Shah, 2013).

Contribution: An informal relationship in which individuals support other's goals (Shah, 2013).

Cooperation: The relationship in which disparate agents pursue similar interests and plan activities, negotiate roles, and share resources. Cooperation involves following common rules of interaction where both parties work to solve a problem (Shah, 2013).

Coordination: Process connecting different agents together for harmonious action that may require bringing people or systems under the same set of rules (Shah, 2013).

Malone (1988) defined coordination as "when multiple actors pursue goals together, the actors have to do things to organize themselves that a single actor pursuing the same goal would not have to do. We call these extra organizing activities coordination" (p. 5).

Disruptive technology: Christensen (2003) described disruptive technologies as bringing a very different value to the market. Disruptive products are usually cheaper, simpler, smaller, and more convenient to use.

Knowledge management (KM): The first generation of KM was systematic and a set of approaches for information and knowledge to flow, and create value in an organization (Rao, 2015). Second generation of KM was information in action (O'Dell & Hubert, 2012).

Lean: George (2003) described lean as being linked to speed, efficiency, and eliminating waste. Lean increases the velocity of a process by reducing waste**.**

Scrum: A standard process that has iterative cycles of planning, execution, and review (Knaster & Leffingwell, 2017).

Scaled agile framework: "The scaled agile framework® (SAFe®) is a freely revealed knowledge base of proven, integrated patterns for enterprise-scale lean-agile development" (Knaster & Leffingwell, 2017, p. 1). Scaled agile framework can be scaled to meet organization specific environments to provide better outcomes and happier employees. Scaled agile framework synchronizes alignment, collaboration, and delivery for agile teams (Knaster & Leffingwell, 2017).

Structure availability: Team members are continually present to respond to requests for assistance or information (Strode et al., 2012).

Structure proximity: The physical closeness of individual team members. Adjacent desks provide the highest level of proximity (Strode et al., 2012).

Structure substitutability: The situation in which team members can perform the work of another to keep schedules (Strode et al., 2012).

Synchronization activity: "Activities performed by all team members simultaneously that promote a common understanding of the task, process, and or expertise of other team members" (Strode et al., 2012, p. 1231).

Synchronization artefact: An artefact generated during synchronization activities. The nature of the artefact may be visible to the whole team at a glance or largely invisible but available. An artefact can be physical or virtual, temporary, or permanent (Strode et al., 2012).

Transformation: "The adoption of new technologies, major strategic shifts, process reengineering, mergers and acquisitions, restructuring into different sorts of business units, attempts to significantly improve innovation, and cultural change" (Kotter & Cohen, 2002: p. ix).

Value: The delivery of maximum value and quality to the customer in the shortest sustainable lead time. Employee morale, physical, intellectual, and emotional safety, and customer satisfaction are other benefits. Value is supported via the four pillars of the house: respect for people and culture, flow, and a continuous flow of critical value delivery; innovation, and continuous reflection and relentless improvement (Leffingwell et al., 2017).

Assumptions

Goldratt and Cox (1992) said 85% of assumptions are incorrect. Proceeding with an understanding that most studies employ assumptions, either deliberate or surreptitiously inherent in the discussion, allows acceptance of alternative views and

more robust research. Scaled agile framework employs the Agile Manifesto concepts which are not absent of assumptions. My research was based on several assumptions:

- The communication between me and the research participants were open and honest; and research participants felt assured of privacy and their identities not made public.
- Research participants were representative of the project transformation population.
- Research participants were knowledgeable of their organizational situation and were skilled sufficiently to propose solutions supporting transformation.
- Research participants had different opinions on ways to transform design and software products.
- Software developers had different understanding from systems engineers of agile development and terminology related to it.
- Systems engineering teams were not well trained in agile processes and may not interpret communications in the same manner as software engineers.

Scope and Delimitations

Simon and Goes (2013) described delimitations as items excluded or included in the study's planning. My study was conducted within deliberate boundaries, including or excluding perspectives and other choices. This study focused on the coordination processes in a global aerospace organization, transforming it to a scaled agile framework from a culture of silos. My research study did not include a detailed discussion of culture,

software processes, or comparative analysis of performance results from the implementation of a scaled agile framework.

Even though scaled agile framework transformations affect the entire organization, the research participants were limited to the project team members in transformation. Each engineering environment varies, and findings from my research study may or may not be transferable beyond the specific population under study. The participants were selected based on their membership on the project team in transformation.

The conceptual framework consisted of the general system theory and the coordination theory. This conceptual framework related to the study and supported the exploratory research of a large organization transformation to a structure critically dependent on coordination and was appropriate for this research. The conceptual framework provided context and aligned with the purpose and the goals of this research. A review of the literature identified challenges of scaled agile framework transformation and determined that there is no significant literature relative to large organization transforming to scaled agile framework. The research and interview questions focused on discovering the perceptions of software developers and engineering teams to coordinate processes employed to facilitate the transformation.

Limitations

This section describes the limitations presented by the qualitative paradigm, case study method, and organization factors outside my control. To constrain the focus on coordination, I examined other factors to identify their integration with coordination

processes and did not include components that did not align with coordination processes. The project and organizational environment were accepted in its natural state and did not represent other organizational environments, which may limit generalizations of the findings. This case study was limited by the behaviors and environment of the specific project team studied and environment. I related to the team coordination methods in context of the environment where the coordination occurred

Credibility-enhancing techniques included member checks and peer reviews to ensure dependability of the research. Credibility was impacted by the time availability of the research participants. Summaries of interviews provided to participants allowed feedback on interview content and addressed responses potentially tainted by personal agendas. Researcher bias was a threat to the credibility of the study, because of my *ad prior* experience as a programmer and systems engineer. To protect against potential bias, I identified any preconceived bias before and after the interviews to mitigate the potential of inserting that bias into analyses.

Significance of the Study

Significance to Practice

Significant advancements in technology have made IT vital to most organizations' daily operations (Bush et al., 2017; Omar, Alijani, & Mason, 2009). The number of organizations that rely on IT for daily operations, and support for management decision-making continues to grow (Omar et al., 2009). According to Guzmán, Mitre, Amescua, and Velasco (2010), by investing in IT, these organizations can remain competitive. However, many IT projects are late, over budget, and devoid of the required features

(Alahyari, Berntsson, Svensson, & Gorschek, 2017; Sharma, Stone, & Ekinci, 2008; Tian, Wang, Chen, & Johansson, 2009). Failure at these rates result in stressful work environments and lost career opportunities. IT projects continue to fail to realize projected gains and competitive advantage in the marketplace.

Many studies show examples of IT projects failing. For example, a bug in the baggage-handling software caused a 1-year delay in the opening of the Denver international airport with a cost of more than $1 million per day (Montealegre & Keil, 2000). Another example showed that the state of Washington terminated the license application mitigation project (LAMP) in 1997 at the cost of $67.5 million (Cohen & Bailey, 1997). The LAMP project initially budgeted at $16 million. In October 2005, British food retailer J Sainsbury wrote off its $526 million investment in a supply-chain management system. The firm was unable to move merchandise from depots and warehouses to its stores because of a failed data warehouse system (Charette, 2005). According to Charette (2005), Kmart initiated a $1.4 billion IT modernization project in 2000 to centralize sales, marketing, and logistics systems and, after 18 months into the project, terminated the initiative, writing off $130 million in IT investment (Montealegre & Keil, 2000). There are potentially many reasons why IT projects appear to fail (Foss, Stone, & Ekinci, 2008; Mähring, Keil, Mathiassen, & Pries-Heje, 2008).

The success of an IT project links to how satisfied the end-users and the business units are with the final product (Korrapati & Nair, 2010a). Systems development is mostly a social process and should have more weight on social matters than on technical dimensions (Klein & Hirschheim, 2001; Lundestad & Hommels, 2006; Parise, Guinan,

Iyer, Cuomo, & Donaldson, 2010). The focus of this study was, therefore, on understanding the transformation to a scaled agile framework and the role that coordination has in IT project success.

Firms push ahead with IT projects to gain a competitive edge, improve their competitiveness, launch new businesses, and introduce management innovations. Lee et al. (2015) noted that projects that are executed on budget and within schedule could fail because the projects do not produce the actual benefits to the customer. A scaled agile framework would identify the failure to provide tangible benefits as not creating value. Projects still continue to fail at a rate of 60 to 80% per year (Curcio et al., 2018; Korrapati, 2013). The purpose of this qualitative exploratory single case study was to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework. Better coordination in the transformation to a scaled agile framework may help businesses achieve profitability and increased market share. Findings from this study may serve to improve working environments and job security.

Significance to Theory

Most of the studies of transformation from traditional waterfall methods to scaled agile framework have been case studies. Fewer than three percent were grounded theory (Gandomani, Zulzalil, & Nafchi, 2014; Jovanović, Mas, Mesquida, & Lalić, 2017) and two studies employed experimentation (Kim, Banks, & Shah, 2017; Salo & Abrahamsson, 2008). Framing the research in general system theory and coordination theory allowed a more focused analysis within the system and the time constraints. Simon

and Goes (2013) advocated the case study provide a basis that can be used for similar situations and applies to real-life situations. Yin (2014) stated that a case study contributes knowledge of individuals, groups, and organizations. Case-based reasoning is a paradigm that suggests a new cognitive model from previous successful experiences. A case study is a blend of psychology and information systems that accommodates engineering concerns with knowledge acquisition (Slade, 1991). Managers and employees who understand the effect of coordination methods on the organization's performance have a higher propensity to develop trust in the work environment and improve working conditions for both management and employees.

This research design offered two contributions to the framework theories. First, this research contributed new ideas to the seminal works of von Bertalanffy (1969) and Malone (1988). The study's findings contribute to the literature on coordination methods that may improve projects' success in transforming the scaled agile framework and supporting future theory development. The organization evolution and adaptation concepts from general system theory and the coordination theory concept of transformed structure and human-machine interface are expanded with the discovery of cognitive diversity.

Significance to Social Change

Documentation of failure rates indicate that 56% of projects deliver without planned value, and 17% of the failed projects directly threaten the company (Liu, 2013; (Rezvani & Khosravi, 2019). Businesses cannot sustain these failure rates, and rapidly changing and disruptive technology is increasing competition, requiring shorter cycle

times, reduced costs, and more significant innovation (Pisano et al., 2015). The consequences to businesses are marketplace loss and potentially closing the business. The consequences to humans in these organizations are more complex. Project failure affects employee security in the changing work environment and concern over continued career movement. Even if an organization implements a transformation to a scaled agile framework, the employees face a chaotic environment of systemic change and confusion.

There was a lack of understanding of coordination processes during scaled agile framework transformation. My exploration of the coordination enablers and barriers provided new knowledge on a coordination method able to reduce project failure rates. A reduction in project failure rates achieved by transformation to the scaled agile framework would provide positive social change to the employees, self-determination of the team's planning, the higher authority to determine their success, more significant opportunity to learn, and new knowledge and innovations.

The success of scaled agile framework transformations may provide positive social change by implementing a methodology that focuses on people over processes (Cockburn & Highsmith, 2001). The self-forming teams and transparency provide a work environment that offers employees the ability to control their future. Increased coordination offers knowledge-workers a clear vision of the expected business goals and a greater understanding of internal and cross-boundary team collaborative efforts. Sham, Titcombe, and Reid (2012) found that the collaboration of people from different skills and backgrounds takes the lead to understand the requirement jointly, and successful transformation to agile appears to be fun and more motivating. Agile teams seem to be

happier and look to create a friendlier environment in which to work. The high failure rate of large projects jeopardizes workers' security and creates a stressful work environment. The study findings may lead to a higher success probability of transformation to agile and scaled agile framework and provide workers the benefits found in the previous studies above.

Summary and Transition

In a dynamic environment characterized by increasing technology constraints and socio-cultural barriers, information management systems became increasingly complex for maintaining and transferring knowledge effectively and sustainably. Software and systems engineering failure rates are high, and organizations are looking for a means to become more adaptive, increase innovation, and reducing cost and cycle times. The conceptual framework of coordination theory and general system theory looked at the transformation with the focus on perspectives, based on the coordination methods employed, that enable software and systems engineering teams to reduce the project failure rate that currently exists.

A summary of the background leading to the evolution of scaled agile framework creation was presented and identified the increasing pace of technology innovations and subsequent business challenges. Disruptive technologies change with more significant acceleration and leave some of the largest organizations behind as newer competitors emerge. The accelerating changes created the necessity to leverage the disruption into opportunity by finding ways to adapt, change, and create value.

The purpose of this qualitative exploratory single case study was to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework. Understanding how the coordination increased success rates for software developers and engineering teams at large technical organizations, transforming to a scaled agile framework can provide positive social change to the employees through collaboration, coordination, and communication identified as critical factors for the success of agile processes. Knowledge addressed enablers, barriers, and coordination methods that improve the realization of social and business benefits sought during scaled agile framework transformation. The scaled agile framework is a social process that values people over processes and benefits of organizations that complete the transformation are reduced costs, reduced cycle times, creation of a friendlier employee environment, and security of employee positions.

Chapter 2 provides a review that critically evaluates current research and literature on the dynamic environment of software development and the continued instability caused by technological innovations outpacing development methods. The evolution of software, the creation of agile development processes, and the current scaled agile framework that encompasses software and systems engineering coordination are covered in the literature review and identify the gap in knowledge—implementing the scaled agile framework in large organizations.

Chapter 2: Literature Review

Organizations in the United States have a gap in knowledge about the coordination that supports transformation to the scaled agile framework, which negatively impacts the success of large-scale software development. The purpose of this qualitative exploratory single case study was to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework. Dikert et al. (2016) and Strode et al. (2012) identified a critical link between coordination and successful transformation; however, they did not discover the means for coordination to close the gap in the knowledge of how projects achieve crucial coordination. Malone (1988) argued that people and computers interacted in rapidly growing numbers and required an increase in flexibility and adaptability. Coordination is the link that impacts humans and creates different perspectives. Knowledge transfer, changing mindset, and cultural shift must exist in organizations transforming to the scaled agile framework. Hui (2013) found large organizations having mixed results and transformation in an immature state. The gap in knowledge of coordination that supports transformation to new methodologies adds insight into successful organizational transformation (Saeeda et al., 2015). Each of these authors found a gap in knowledge of coordination and how coordination supports transformation to new software development methodologies (Saeeda et al., 2015). This lack of understanding of coordination methods prevents organizations from successful large-scale development projects.

Chapter 2 covers the literature search strategy in conjunction with the conceptual framework that bounded the research. This chapter contains synthesized knowledge of

the current literature from the perspective of large scale to scalability, communication, collaboration, and coordination, psychosocial influence, and importance of scaled agile framework and coordination to business. Chapter 2 also includes a critical analysis of the literature that helped to structure this study.

Literature Search Strategy

This research study concentrated on research regarding the following elements: (a) agile, (b) scaled agile framework, (c) system engineering, (d) lean, (e) software development, (f) coordination, and (g) collaboration. Several databases were used to query multiple binaries to single keyword search strategy in Academic Search Premier, Academic Search Complete, ERIC, ProQuest Business, SAGE, IEEE Xplore, MIT Open Access Articles, and ABI/Inform Complete. The queries used the keywords *agile, scaled agile framework, transformation, coordination, collaboration, flexibility, adaptability, knowledge*, and *software development*. This review was limited to the years 1960 to 2018 and covered both articles and books to identify foundational literature in the field of agile, scaled agile framework, coordination, and transformation management.

Two internet search engines, Bing, and Google Scholor search were used with keyword searches during the second phase to identify potentially relevant articles or other resources missed during searches of the academic journal databases. After reviewing the initial search results, a refined search used synonyms unique to a database and then created wildcard combinations to produce the most comprehensive array of articles. Keyword and key phrase searches used included: *organization transformation, scaled agile framework, software development, system engineering*, and *coordination theory*,

and subsequent searches reduced keyword selections. Additional searches included full-text and peer-reviewed articles between 2000 and 2018. The study topic is a business problem. ABI/INFORM Complete had the most appropriate resources for the topic, making ABI/INFORM a logical choice as the primary database for the literature review. IEEE Xplore had a significant number of relevant articles that focused on the agile and scaled agile framework. The MIT Open Access Articles was an excellent source for coordination theory articles. Literature searches for items produced between 2016 and 2018 provided recently published material and the most significant studies on the scaled agile framework. Reference lists attached to reviewed articles offered additional leads.

Conceptual Framework

This study was bounded by two concepts that focus on the evolution of systems and coordination: (a) von Bertalanffy's (1969) general system theory, and (b) Malone's coordination theory (1968). The attention given to large-scale transformation and coordination addressed logical connections among humans in the system, growth of technology, adaptation to evolving systems and organization changes, increased information, and the problems coordinating in this new environment (Amici & Bietti, 2015; Bush et al., 2017; Butchibabu et al. 2016). A common finding among scholarly research was the identification as coordination as a critical success factor in successful large-scale organization transformation (see, for example, Eriksson & Stanton, 2015; Lee et al., 2015; Strode et al., 2012)

A general system theory was developed by von Bertalanffy (1968) that focused on the wholeness of the system. General system theory perceived integrating the various

sciences in a central theory to include nonphysical disciplines. In the system concept, is an interrelation between the system elements and the environment. As part of the theoretical framework, von Bertalanffy used the concepts of man-in-the loop, evolution, information and adaptation, and organization to understand the system as a group of independent and interrelated parts that are influenced by the environment. The information and system feedback operations are explained in the closely related communications theory. The feedback mechanisms are a method of coordination.

Malone's coordination theory (1988) was a significant initiative at applying the concepts of technical and human organization. Others would add to this theory to bridge the gap in the literature regarding the relationship between coordination methods and organization changes (Malone & Crowston's, 1994). Coordination theory identified that many people had acquired direct access to computers. The dramatic improvements in the costs and capabilities of information activity in computer science involved the exploration of various methodologies and a growing recognition of the commonality of theoretical problems in a variety of disciplines. The same phenomena appeared in many domains (Malone, 1988; Malone & Crowston, 1994).

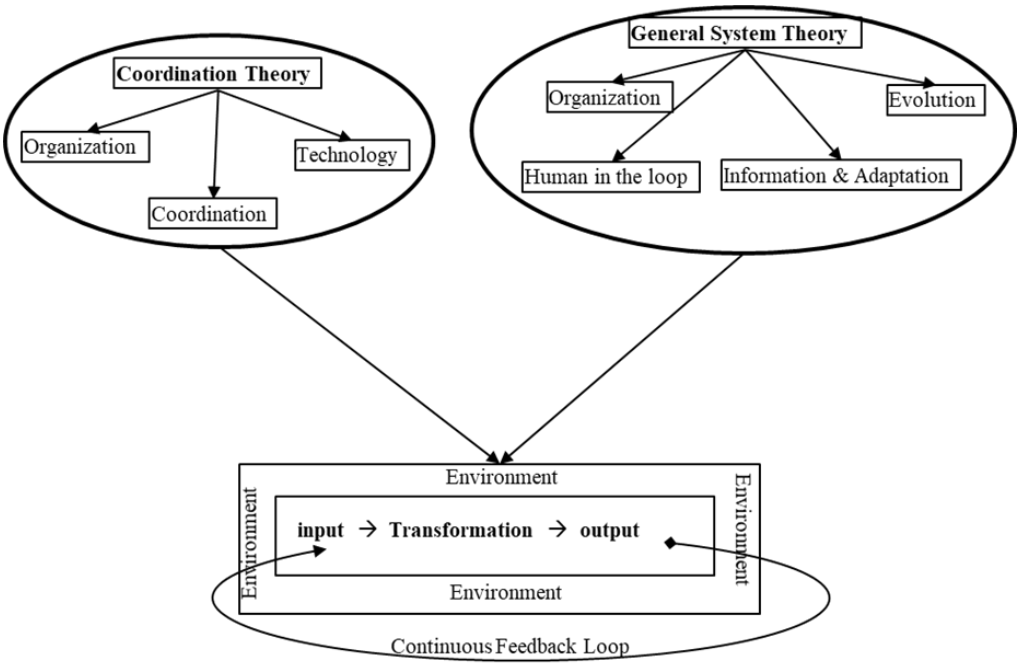

Figure 1. Conceptual framework of general system theory and coordination theory.

Multiple perspectives create the expectation that new empirical insights and new systems stimulate new theory, and the concepts from one domain lead to an application in another realm. Abstractions of coordination theory are the critical interconnecting link to facilitating new connections. Coordination theory works in and contributes to many fields, like the concepts of the general system theory by von Bertalanffy. Coordination among humans facilitates collaborative and cooperative behavior; even though little knowledge exists about the exact way coordination, collaboration, and cooperation are linked (Amici & Bietti, 2015).

As the global economy accelerated, technological advances had customers demanding faster and better quality in information technology software development (Hobbs & Petit, 2017; Khmelevsky, Li, & Madnick, 2017; Lindvall et al., 2004). Strode et al., 2012) preformed a comprehensive review of the current literature to investigate the

methods and relationships of coordination in a transformation. Xu (2011) examined agile projects applied to large software projects, coordination strategies, and how coordination could help the transition and greater coordination in large projects. Fry and Greene (2007) saw the problem of not having a cohesive coordination strategy for large scale projects as the means to create a significant and fast agile project transformations, and when a company grew too quickly, it became a challenge to management.

Saeeda et al. (2015) explored missing knowledge about agile scalability for large scale projects. Saeeda et al. explored lessons learned which allowed organizations to scale with the growth that came with large projects. The interrelationship between computer systems and humans exhibited the complexity Malone (1988) had identified in his theory of coordination. Maples (2009) contributed to the environmental concepts within the conceptual framework by identifying enterprise agile transformation as an ongoing process and Xu (2011) explored coordination strategies needed to develop larger-scale agile projects. Adaptation of a shared mindset, coordinating work processes, and feedback mechanisms impacted effective coordination critical to the success of these projects (Dingsoyr, Faegri, Dyba, Haugset, & Lindsjorn, 2016).

Senapathi and Srinivasan (2012) investigated the social aspects of the coordination gap and used attitude to show how the team's positive or negative beliefs could determine if the team continued innovation and increased productivity. Shah (2013) investigated the effect of awareness on coordination and collaborative information-seeking projects, and awareness supported the impact of collaborator's behaviors. Awareness views of employees varied in different work environments (Inayat & Salim,

2015). Various groups saw different aspects of the same problem, and exploration of those differences and standard solutions are necessary to reach a successful outcome (Duque, Bravo, & Ortega, 2013).

Coordination on a project continually evolves, increases uncertainty, and interrupts work environments, and becomes more essential to transformation as it continues to scale upward (Strode et al., 2012). Amici and Bietti (2015) looked at the interdisciplinary perspective of cooperation, coordination, and collaboration. They found high levels of coordination and human activities appeared to facilitate collaborative and cooperative behaviors, although little knowledge exists about being linked to each other and affecting the emergence of cooperative strategies.

Diverse disciplines serve as a collaborative nexus of ideas that benefit transformations (Bergmann, Dale, Sattari, Heit, & Bhat, 2016), and a collaborative work environment provides mechanisms that facilitate informal interchange (Metz et al., 2015). Coordination is a significant challenge for transformation and is omnipresent and affects all aspects of an organization (Brenner et al., 2015; Gill, 2015). In the transformation, team complexity is increasing, and there is more interdependence among previously independent teams. There is a consistent relationship between implicit coordination and team performance (Strode et al. 2012). Therefore, as complexity increases, coordination needs to improve (Butchibabu et al., 2016).

The culture was investigated and found to be a critical factor in agile success (Strode et al., 2012; Booch, 2007). Psychologically, there is a subtle but essential refocus of perspective (Booch, 2007). The culture and refocus needs an adjustment in member

behaviors and perseverance (Sham et al., 2012). Vijayasarathy and Turk (2012) found corporate culture plays a role in the adoption, engineering implementation, user participation, and top management support. In a similar focus, Drury, Conboy, and Power (2012) found that when one key member leaves the team, it may result in a team iteration not being completed on time.

Human resources and social interactions were more significant issues than most technical issues during transformation. Muhammad, Saahar, Hasan, Fiah, and Nor (2014) found a lack of human resources an impedance to the flow of information that was only surpassed by excess red tape and bureaucracy in the organization. Shah (2013) found agreement with Conforto, Salum, Amaral, da Silva, and de Almeida (2014) while investigating the role awareness played in collaboration and shared resources achieving common goals. The lines between digital and physical worlds have been blurring, and a comprehensive approach now translates these new trends and includes psychosocial inquiry into the human and social areas (Eriksson & Stanton, 2015. Conforto et al. determined that knowledge management is collaboration, and a means to advance knowledge collectively at the organization and social levels. Waldron (2017) focused on individuals and improved productivity and rethinking the work environment. The success of evolving work environments and adaptation of the people within that work environment involves understanding and structuring of the organization that supports the human psychosocial knowledge, reduce resistance, and create a more cohesive work environment (Gordon et al., 2013; Shih et al., 2013).

To focus directly on business aspects before having investigated and attended to psychosocial factors is like building the roof of your house before you created the foundation (Lee et al., 2015; Pisano et al., 2015; Vrhovec, 2016). Transformation to the scaled agile and successful execution of large-scale development integrates the entire organization (Glaiel et al., 2014; Wiewiora et al. 2013) and the concept of business value and prioritizing tasks associated with higher value was a new concept (Farrow & Greene, 2008; Lee, 2008). Xu (2011) looked at the business environment and the disruption caused by technology changes. Sham et al. (2012) examined the mindset approaching the innovative organization and using agile methodologies. The ability to innovate becomes related to the speed of the development process. It allows continuous change (Huang & Knuth, 2012), and transformation to agile and scaled agile framework follows a similar pattern identified by Deming (2018) and known as the plan-do-check-act (PDCA) process (cited in Gandomani et al., 2015, p. 87). The transformation process between different domains must have common concepts where shared information helps achieve common goals between disparate functional groups (Brown et al., 2013; Dyba & Dingsoyr, 2015; To, 2009).

Amici and Bietti (2015), Conforto et al. (2014), and Hui (2013) looked at the uncertainty in organizations attempting to transform into large-scale development. Hui found that introducing change to the organization without buy-in at all levels fails. Diverse areas of businesses are now linked and related and must communicate with each other to perform value development for customers (Alahyari et al., 2017). Transformation methodologies use a holistic approach that creates new trends that occur where digital

and physical worlds begin to blur (Brown et al., 2013; Farrow & Greene, 2008; Pisano et al., 2015). Lee et al. (2015) found individuals are more cognitively connected when their job is perceived to be fulfilling, and employees psychologically relate to their job identity positively correlates with individual attitudes and organizational status. The human aspect of the man-machine concept is related to the coordination theory. The theory considers the interface of cognitive, social processes, and knowledge skills (Metz et al., 2015). More than just change needs to occur during transformation. Transformation requires reinventing social and technical processes and methods (Dikert et al., 2016; Dingsoyr et al., 2016).

Literature Review

Coordination and the Evolution of Scaled Agile Framework

Since the 1960s, there has been a series of developments to align software development with hardware development. The leapfrog process continued to create a crisis in the development process. The Agile Manifesto created a standard set of principles for developers and appeared to be a solution. Since agile focused on small to medium-sized teams that were collocated, that solution was not a total solution. The global economy was accelerating, and technological advances had customers demanding more features, complexity, projects completed faster, and better quality (Hobbs & Petit, 2017; Khmelevsky, Li, & Madnick, 2017; Lindvall et al., 2004). These new demands required larger organizations producing larger projects to consider the use of scaled agile framework was introduced in 2011 to accommodate the large-scale development. The

transformation to the large-scale development and implementation of a scaled agile framework introduced new complexities and new areas of innovation.

Reviewing and grouping the literature provides four major functional areas explored to find how coordination functions within a system that is in transformation. Those four areas included (a) large scale to scalability; (b) communication, collaboration, and coordination; (c) psychosocial influence; and (d) the importance of scaled agile framework and coordination to business. Tracing interrelationships across the literature indicated that when each of the four factors intersected this provide insight into areas where critical events occurred.

Large scale to scalability. Between 2003 and 2012, large-scale and scalability were major discussion areas. Agile paved the way for a process that can implement lean and support some scalability, as well as those principles of the Agile Manifesto. The emphasis seemed to change around 2012 from the words large-scale to scalability. The terms flexibility and adaptability also gained focus and became more prevalent and more associated with the transformation. When there were more interactions among hardware and software, there seemed to be more user issues. Additionally, there may be a relationship between a more complex organizational structure, and the likelihood of the organization to experience a transformational failure (Charette, 2005).

Soundararajan and Arthur (2009) investigated accommodating changes to a complex and large-scale system and what methods might be employed. The technology was growing and evolving, and business work environments were failing to maintain that adaptation. The terms *evolved* and the *environment* were critical terms related to the

ability of the humans in the loop to manage and adapt to rapidly changing technology, directly associated with transforming to a large-scale development environment.

Xu (2011) examined agile processes that applied to large software projects. Xu asked the question about coordination strategies that were available and how coordination could help in the transition. In the study, Xu asked how agile processes are applied to achieve agility within large project environments. The rapid change in technology and business environments currently was pushing the envelope and driving the need to use agile in large-scale environments. Xu saw a need for more significant coordination strategies in large projects and identified several challenges, which needed to balance agility and discipline when adapting to a large-scale project.

Xu (2011) referenced Malone and Crowston's coordination theory and felt the theory did not include humans in the process. Several, more recent studies expanded on coordination theory and attempted to relate the coordination required for large-scale projects and the interaction between machine and human participants (Šmite et al., 2017; Strode et al., 2012; Xu, 2009). The identification of massive information flow and the need to achieve standard outputs became one of the central focuses. A constant adaptation requires constant collaboration, and subsequently, a collaborative environment at the organizational level is required. Fry and Greene (2007) did a case study on large-scale agile transformation. Fry and Greene saw the problem as the means to create a significant and fast agile transformation, and when a company grew too quickly and became a challenge to management, how could release cycles improve? Cross-functional teams required a ground-up redevelopment redesign. A problem at the time of the study

was that there were no interconnectivity or feedback mechanisms to support cross-functional coordination.

Saeeda et al. (2015) focused on agile scalability for these large-scale projects. Scalability referred to the widespread problem that existed but focused on lessons learned within organizations. Saeeda et al. argued that by having well developed projects that were documented properly and tested using multiple groups, an organization could scale up without adverse repercussions. Focusing on lessons learned was a directly opposite approach to Charette's (2005) statement that organizations appear to be unable or unwilling to learn from their mistakes. Charette saw that the concept of agile had proven successful in small and medium-sized projects, but its limitations, when applied to large-scale projects, left many questions unanswered. There was knowledge missing between the research and the practical information of these processes, and many projects attempted to apply agile on large-scale projects and did not return the desired results.

Scaling is not congruent with agile methods that emerge across large-scale projects (Vrhovec, 2016). Scaling needed to be more concerned with techniques for developing large systems in a new environment because the small teams could not produce these large-scale projects. Changing the focus from impacts on specific areas due to agile, to the exploration of interoperability and complementary lean-agile methods within software product and its associated engineering methodologies, were applied to reach some answers. Additionally, applying the learnings from previous research has also improved the implementation of scaling agile initiatives. There were relationships between uncontrolled growth and increasing risks in these large developments.

Large-scale development introduced many new challenges and continuously tested organizations searching for a means to coordinate between teams, and Hsu, Lin, Cheng, and Linden (2012) explored the effectiveness of knowledge to mitigate requirements instability. Inayat and Salim (2015) focused on requirements to live in collaboration among agile teams. Inayat and Salim used two individual case studies that revealed a framework that helps collaboration in dispersed teams. Turetken et al. (2016) focused on one case. Still, they added the dimension of the need to establish a maturity model guide for software developing organizations adopting a scaled agile framework that allows for assessing the implementation of agile and scaled agile framework practices in an enterprise.

The collaboration of the requirements was extensive and more complicated, with teams not co-located. Activities became highly volatile, and constant collaboration was required to achieve any success. Teams in transition do not influence on the time the change occurs and may not have adequate time to move from one activity to the next (Bush et al., 2017; Cohen & Bailey, 1997; Glaiel et al., 2014) Coordination was becoming a central theme as opposed to a sub-note in the effort to become a large-scale developer. Coordination had been a central theme from the time that the Agile Manifesto had been released and was becoming more a fundamental concept since the introduction of a scaled agile framework (Knaster & Leffingwell, 2017).

Communication, Collaboration, and Coordination

Charette (2005) discussed poor communication among customers, developers, and users as one of the barriers to handling project complexity. Poor management is an

example of bad dialogue, and the organizational environment is defined to include culture and communication and collaboration as a potential means to resolve errors from earlier works. Wirth (2008) explored a history of software engineering and the effects of coordination in a collaborative information environment. The relationship between software engineering and technological improvements are associated with a systemic process

The hardware had been the limiting factor to increasing software capability, but the hardware to software capacity changed, and now software was required to meet the capabilities of rapidly growing hardware (Wirth, 2008). The changing abilities of hardware development put significant demands on the programmers, and the transition would be much more complicated than was anticipated. The need for complex software systems could not be completed on time by developers. The interrelationship between computer systems and humans realized the complexity that Malone (1988) had identified in his theory of coordination. Maples (2009) identified transformation as an ongoing process; and even though agile allows flexibility, there are segments of the organization that are not flexible. Without coordination, there is a wedge between the different groups in the organization, and as friction arises between business inflexibility and agile culture, there is an increased risk within the organization.

Maples (2009) strayed from other studies in his approach to organization transformation. He introduced the different business areas of the organization and the interface of the software and engineering goals conflicting with support business goals. Xu (2011) explored the coordination strategies needed to develop larger-scale agile

projects. Agile would become more of a requirement than a choice as technology increased, and business environments attempted to adapt. Greater focus on improving customer satisfaction and typical characteristics of the self-organizing teams would require more significant interaction and communication between teams and reduced resources. The adaptation of all these changes impacted effective coordination, which is critical to the success of these projects.

Agile methods inherently advocate coordination strategies, and large projects need to balance their structure and agility when choosing these coordination methods. Coordination methods include daily standups, co-located teams, collective code, pair programming, and iterative planning standards (Xu, 2009). Agile methods supported these coordination practices and envisioned them in an informal management style. As the size of these projects continues to increase, close interaction among project team members becomes more and more stressful. Large projects do not support decision-making only through informal means, because complexity and numbers increase miscommunication and misunderstanding and make the resolution more difficult. More strategic methods must support informal strategies. Communication needs to be facilitated by the boundary spanners or people who would work across boundaries (Glaiel et al., 2014).

von Bertalanffy's general system theory suggested that different units in one organization usually establish their norms and values, and the new environment adds significant complexity to communication across those boundaries (Xu, 2009). Lee (2008) took a different approach to other studies and framed the transitioning to large-scale

projects with Tuckman's (1964) forming, storming, norming, and conforming model. Lee not only discussed changes in senior management but discussed communication among team members not co-located. In the norming phase, collaboration becomes very important and is the key to success. Strode et al. (2012) studied coordination in co-located agile projects and first asked what activities support the coordinated actions. Second, what characteristics exist in a highly correlated state? How do projects achieve coordination, and what is the relationship between coordination strategy and project coordination?

Coordination supports highly independent subunits and to help boundary spanning. Countering coordination is the expansion and complexity of large systems that include external members and more significant obstacles to successful coordination (Strode et al., 2012). Korrapati and Nair (2010) expanded the concept of colocation to globally distributed coordination. Senapathi and Srinivasan (2012) used an attitude to show how the team's positive or negative beliefs could determine if the team continued innovation and increased productivity. Shah (2013) investigated the effect of awareness on coordination and collaborative information seeking projects. How does awareness relate to coordination and subsequently to the collaboration of the entire project coordination? What do collaborators know about the group status, and what direction the group is moving? Awareness supported the effects of collaborators' behaviors.

Awareness involves knowing. Knowing who is involved, who is around, what activities are occurring, and who is talking with whom. Awareness shares different views in daily work environments (Strode et al.,2012). Coordination and collaboration are

related, and coordination is an essential part of the collaboration. Collaboration is desired as part of any complex project and is vital to the success of that task (Dyba et al., 2015). The relationship between complex projects and required coordination critically affects more complex engineering infrastructures (Shah, 2013). Communication is the process of sending or exchanging information. Cooperation relates to different agents with similar interests aligning to achieve common goals (Shah). The contribution is an informal relationship involving individuals helping each other achieve personal goals. Coordination connects groups with different agendas to create a harmonious situation in a collaborative environment (Shah).

Different groups see different aspects of the same problem, and exploration of those differences and standard solutions become necessary to reach a successful outcome. Duque, Bravo, and Ortega (2013) advocated and investigated an approach to automating collaboration. Duque et al. investigated using several factors to improve collaborative work, including, when to intervene, what condition should exist, the place where the intervention occurs, and what information to use. Duque et al. grouped collaborative work and collaborative interaction analyses and found their ontological framework to support software developers using sets of models to perform analysis. Gallardo, Bravo, Redondo, and de Lara (2013) chose to study collaborative protocols to apply to collaborative modeling tools. These collaborative modeling systems provide collaborative paradigms to the construction of their models. The model is to allow users to build diagrams modeling blocks and relationships between them and indicate a lack of a complete solution to the specific attempts of collaborative modeling systems.

Computers can provide collaboration of processes in units that are geographically separated. The separate groups may employ different artifacts, while the models may need to be synchronized to allow access to these workplaces (Gallardo et al., 2013). There is a need for a collaboration protocol. Muhammad et al. (2014) constrained their study to the logistics industry in Malaysia. Simple questions included what communication methods employed in the logistics industry and what communication tools were most effective. One common finding was that the computer was the top communication method and was rated the most effective communication tool.

In contrast, Charette (2005) found poor communication among customers, developers, and users as one of the barriers to handling project complexity. Poor management was an example of bad communication, and the organizational environment was defined to include culture and communication and collaboration as a potential means to resolve errors from earlier works. Wirth (2008) explored a history of software engineering and the effects of coordination in a collaborative information environment. The relationship between software engineering and technological improvements were associated with a systemic process.

Visual information and cues. A significant finding was that too much red tape and bureaucracy greatly and negatively affected communication. Lack of human resources is a substantial obstacle in the coordination and communication within the logistics system. Gergle, Kraut, and Fussell (2013) explored the use of visual information for awareness in collaboration tasks. They identified technology that could transform visual information in ways that would be critical to the coordination process. Gergle et al.

examined the coordination process that could impact visual information and situational awareness through conversational grounding. They found that developing collaboration tools without a thorough knowledge of how the group worked and coordinated their activities created obstacles to complete collaboration. Gergle et al. (2013) found that visual information plays a critical role in coordinating. Sharing of visual information in a collaborative activity provides critical cues for successful collaboration. These shared objects can lead to successful collaboration.

Gergle et al. (2013) identified that there were lower rates of verbal discussion because of shared visual cues. The study is important because it determined that the cycle time of any activity reduced in direct response to shared visual cues that reduce necessary verbal discussions. The study revealed that visual information supports conversational grounding in an immediately available work area and provides a shared view that helps reduce linguistic complexity and improves performance. Visual information synchronizes the field-of-view of all disparate teams. When the rate of change is swift, visual feedback can quickly update situational models of the current environment (Kim et al., 2017). Snyder (2014) also explored the visual representation of information as the focus of the communication process.

Image making, or images of information, provide a unique form of information and communication (Snyder, 2014). The spontaneous act of drawing during a face-to-face discussion is a form of social interaction and information sharing. Spontaneous drawing is related to heightened creativity, insight, and coordination (Gergle et al., 2013). The spontaneous visualization represents a particular context and environment of the

social interaction activity communicated. The display of these images provides an interactive dimension to the collaborative event and enables information to be stored and transformed into something new. Visualization is a bridge between knowledge domains and shows graphic images can reduce excessive formal actions (Snyder, 2014). Too much red tape and bureaucracy significantly impact communication effectiveness. The lack of human resources is a significant obstacle in the coordination and communication within the logistics system. Gergle et al. explored the use of visual information for awareness in collaboration tasks. The study interest was in identifying technology that could transform visual information in ways that would be critical to the coordination process. Gergle et al. examined the coordination process that could impact visual information and situational awareness through conversational grounding. The study found that developing collaboration tools without a thorough knowledge of how the group worked and coordinated their activities created obstacles to complete collaboration. Gergle et al. found that visual information plays a critical role in coordinating. Sharing of visual information in a collaborative activity provides critical cues for successful collaboration. These shared objects can lead to successful collaboration.

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Metz, Marin, and Vayre (2015) explored the shared use of the whiteboard as a tool creating cognitive synchronization and collaborative design. Their study examined whether a shared whiteboard would help remote design collaboration. The current environment consists of geographically separated units using electronic white boards and has different professional disciplines needing to work together collectively. The obstacle is developing a shared goal that all must carry out and to integrate social, technical, and organizational aspects into each task. Integrating social, professional, and corporate issues can become even more complicated in a global society where complexity increased due to culture, geographical locations, languages, and cognitive concepts. It is essential

that each person understand the other and that cognitive synchronization occurs by communication between different participants and justifications. There is a synchronization relationship that depends on the coordination and actions of team members, referred to as group awareness (Metz et al., 2015; Shah, 2013).

Social, technical, and work environment. Pisano et al. (2015) explored innovative models that enabled timely reactions to ongoing changes in the work environment not predicted. Pisano et al. found a relationship between social attitude and collaboration in the context of a global framework, and complexity increases with new customers. The ability to identify and correct problems quickly afford the ability to find new solutions. Malone (1987) expected the number of alternative coordination structures to increase as the number of processors increased. Malone, Nickerson, Laubacher, Hesse Fisher, DeBoer, Han, and Towne (2017) expected that suppliers at each level could devise several alternatives and innovate solutions that adapt to the changing market. Different areas of business can be linked and related to each other to communicate a complete customer value list.

Inayat and Salim (2015) conducted two cases to study the requirements delivering collaboration among agile teams and identified factors of these teams in a socio-technical system. The study tracked information flow and information exchange, and attempted to identify a tendency to increase communication. The study defined collaboration in terms of communication and being cognizant of the knowledge of others. The collaboration came from the perspective of the participants and their characteristics. From its inception, agile has emphasized the need for extensive collaboration between customers,

developers, and the small self-organized teams, which were assumed co-located. In a socio-technical system, constant collaboration occurs, especially with non-co-located teams, to maintain flexibility to adapt to continually changing requirements.

Gill (2015) found a systemic approach to the investigation of social factors and agile teams. Gill explored large enterprise agile software engineering and scaling agility at the enterprise level. The study found that large-scale software engineering at the academic level had to adjust significantly since large-scale software engineering occurred in multiple semesters. A lack of significant up-front preparation leads to chaos and shallow feedback. There is a direct relationship between the teaching and application of software engineering at the large-scale enterprise levels due to increased complexity. Participants must stay fully immersed through the entire formative feedback process. Brenner and Wunder (2015) investigated a real-world example of a scaled agile framework. Their perspective was that the scaled agile framework applies agile methods to the entire organization. In such a structure, as outlined by Brenner and Wunder, teams align with different agile release trains where a team of teams works together on shared values. Meetings and the flow must synchronize through each iteration.

The synchronized meetings in the scaled agile framework reduce the coordination complexity between teams and foster a common goal and commitment of all participants involved (Brenner & Wunder, 2015). Inayat, Salim, Marczak, Daneva, and Shamshirband (2015) compiled a systemic literature review on agile requirements and practices and the challenges faced for these transformations. Software engineers had a high probability of being exposed to agile after 2001. However, system and hardware engineers were less

likely to understand the intricacies and concepts involved in agile and scaled agile frameworks. The increased interaction with the customer and sometimes dramatic changes to the processes made teamwork essential to reduce the communication lapses and enhance knowledge sharing. Saeeda et al. (2015) explored lessons learned during large-scale project transitions. An area of interest was the area of project visibility, coordination and effectiveness, and productivity.

Coordination, teams, and quality. Uncontrolled growth in these large-scale projects increased organizational risk and disclosed that scaling could become a problem when applying scrum in large enterprises (Saeeda et al. 2015). Management overhead showed a need for coordination between teams, and there was a long waiting time for requirements for engineering due to the complex decision-making process in traditional requirements engineering (Inayat et al., 2015). Dyba and Dingsoyr (2015) explored the self-managing aspect of teams transitioning to large-scale development. Dyba and Dingsoyr put less emphasis on the upfront plans the informal collaboration coordination and more emphasis on learning which became critical, and a means to reduce complexity and new challenges to the organization (Gombolay, Jensen, Stigile, Son, & Shah, 2016). Gandomani et al. (2014), Dyba and Dingsoyr (2015), and Gombolay et al. (2016) used self-managing teams and the addition of new knowledge to form a new group and reduce product risk.

Projects require more coordination as they evolve, increase uncertainty, and interrupt work environments as the project continues to scale upward. Amici and Bietti (2015) looked at the interdisciplinary perspective of cooperation, coordination, and

collaboration. The high levels of coordination and human activities appeared to facilitate collaborative and cooperative behaviors. Little knowledge is available about coordination, collaboration, and cooperation as being linked to each other and affecting the emergence of cooperative strategies brought together. These contributions from multiple perspectives on coordination assist in the primary goal of providing a better understanding. The diverse disciplines serve as a collaborative nexus of ideas that would benefit the transformations (Bergmann, Dale, Sattari, Heit, & Bhat, 2016).

A collaborative work environment provides mechanisms that facilitate informal interchange and provide added coordination. Eriksson and Stanton (2015) explored what happens when communication breaks down. As the system becomes more complex, there is a need to escalate these cognitive activities. Dikert et al. (2016) explored factors relative to large-scale agile transformation. Large-scale projects need additional coordination. These larger projects require attention to inter-team coordination, and coordination involves other concerns. The goals of independent teams may differ in that one team's coordination methods may not work for another. Coordination is a significant challenge for transformation. Lindsjorn, Sjoberg, Dingsoyr, Bergersen, and Dyba (2016) looked at teamwork quality and project success in software development. Lindsjorn et al. reviewed factors that affect team performance and used quality as the primary source for measurement and found teamwork quality and team performance are highly related.

Referencing the agile development methods, teams enable collaboration coordination and communication. Using agile quality of the teamwork refers to the quality of the interaction, the interdependent tasks require and call upon collaboration.

Interaction among members minimizes social downtime and promotes a shared commitment to the team's work (Lindsjorn et al., 2016). Lindsjorn et al. found that in the dynamic process, the shared commitment reflects in the group's tenacity to stick together and remain united, otherwise described as cohesion. Gandomani et al. (2014) explored a developed framework for agile transition and adoption from the grounded theory perspective. Adoption of these new frameworks takes a long time, and the framework can conceptualize the collaborative activity (Duque et al., 2013).

Since transformation affects all aspects of an organization, transformation is an evolutionary process and involves the collaboration of all practices. Organizational behaviors and cultures are predominate features in organizational transformation (Jovanović, Mas, Mesquida, & Lalic, 2017). Butchibabu, Sparano-Huiban, Sonenberg, and Shah (2016) looked at coordination strategies for effective team communication. When team complexity is increasing, there is more interdependence required among the previously independent teams, and there is a consistent association relationship between implicit coordination and improved team performance. Implicit coordination focuses on anticipation of information or resources that other team members may need where explicit coordination is the actual transfer of information as requested.

Coordination relationships. One relationship to note is that the increased pressure of time constraints requires greater coordination. Another connection to note is that teams that exchange information during the performance of the task perform better. As task complexity increases, more interdependence among team coordination is required, and the interdependence is a link. Therefore, as complexity increases,

coordination needs to increase. To (2016) looked at collaboration preconditions and contingencies. Knowledge management collaboration, to advance knowledge at the organizational and social level, is required. Software development can be ill-defined, ambiguous, or unique work and teams need to communicate and use relevant knowledge, which, when coordinated can yield better outcomes.

Kudaravalli, Faraj, and Johnson (2017) looked at the approach to coordination expertise in software development. Agile methods suggest decentralization of coordination expertise to reduce bottlenecks in team communication. Decentralized coordination expands alternatives, while centralized coordination reduces coordination needs. Malone and Crowston (1994) performed an interdisciplinary study of coordination. Malone and Crowston's succeeded Malone's 1988 theory of coordination and predicted the transforming organizational concepts that would occur as technology and development programs increased in scale. Malone and Crowston (1994) sought to understand the effects of information technology on human organizations. Malone and Crowston determined the necessity to understand the fundamental constraints and imagine new possibilities. That study identified the need to look for analogies of how coordination occurs in the different systems. The study identified cross-disciplinary interaction and echoed the concepts from von Bertalanffy's general system theory. The basic question was, are there fundamental processes that occur in all coordinating systems?

Again, there is a direct reflection on von Bertalanffy's general system theory concept that multiple disciplines have certain essential functions in common. Malone and

Crowston (1994) preceded the Agile Manifesto and included the need for coordination in human systems to understand computer or biological systems, which is a reference to von Bertalanffy's general system theory. Coordination is defined as an interdisciplinary nature that affects IT and human organizations. Malone and Crowston (1994) described coordination as managing dependencies between activities. The different disciplines mean ideas cross back and forth across disciplinary boundaries and identify opportunities for new development and new ideas.

Identifying coordination processes can help to manage dependencies and provide progress. Malone (1988) created the coordination theory and indicated there were common factors across different disciplines that deal with the coordination of separate participants. The suggestion was that new coordination structures between the electronically connected world of the future and the humans that function within those systems organizations have different components within their organization different ways of doing things and different purposes. Coordination is then distinguished from production because coordination tasks are the information processing portions.

Coordination theory identified working within multiple fields, including economics, computer science, sociology, psychology, and management information systems. The problem statement defined that if organizations do not coordinate, the organization pays the price in wasted resources and creates new problems. Coordination is an activity that has its costs and benefits, and adaptive organizations reduce coordinating costs and therefore reduce the cost of coordination due to technology changes. There is the potential to provide knowledge management goals for the

organization's seeking them. The intent of coordination technology includes the support for activities where the competition of other interests creates barriers. The concept of competition of other interests may explain why scaled agile framework processes can improve system throughput.

There is a connection between coordination theory and coordination technology, and one must have some idea of the goal and the participants involved to make these synergistic traits. The general system theory concept of evolution and innovation coordination focus on previously considered concepts in different fields and finds the commonality between them. Both cognitive science and coordination theory focuses on problems already regarded as separate fields. In coordination theory, electronic media brings together and coordinates the people with diverse knowledge and skills needed for future teams. There is a recurring theme across functional areas of large-scale transformation and coordination activities that is supported by both the general system theory and the theory of coordination that there is a cognitive presence across all aspects of organizational transformation and that human functionality is a significant portion of any organizational system affected during the transformation to scaled the agile framework.

Psychosocial Influence

Psychosocial factors become one of the dominant pillars in the house of a scaled agile framework. Charette (2005) provided a high-level view of why social psychological factors should be a significant pillar of the scaled agile framework and indicate some extreme consequences to the failure of psychosocial adaptation in the environment. One

consequence of failure showed that the ultimate IT failure results in the elimination of our way of life. That means the end of the organization as a viable entity and personal careers and life-support systems. Maples (2009) discussed the possibility of an agile culture eroding rapidly. The trust factor is directly affected by culture erosion and that without trust and empowerment of the team, efficiencies fail. The next operation as a customer concept can be applied here to reduce friction and mistrust, instead of looking at the organization culture, as Maples (2009), Lee, Park, & Koo (2015) identified a higher-level National culture and the organization embedded in that culture.

Culture is a critical factor in the success of agile and must have a culture of trust to be aware of factors that can impact employees. Education, partnership with executives, training, and willingness to adapt all steps in the value chain are essential and provide an understanding that agile is a continuous journey. Booch (2007) explored collaborative development environments and found that ultimately the quality of the system is directly the responsibility of the development team and their direct labors. Collaborative environments are team-centric and focus user experience on the needs of the team. Psychologically there is a subtle but essential refocus of perspective. Teams create a collaborative design or development environment that is different because software developers must manipulate deep artifacts with equally deep associations among teams and through IT resources from either short or long physical distances. Cross-functional teams are redesigned from the ground up and function through several iterations and listening to the customers that match the agile methods.

Sham et al. (2012) and Lee (2008) discussed the need for an adjustment in member behaviors and that perseverance would be crucial to team successful agile transformation. Sham et al. realized that agile is changing and will become something else in the future. Context customizes pure agile, and management pushes for a financial answer to all decisions. In a similar movement, alignment, and environmental structure of the organization would have to recur in concert with these behavior changes. Lee chose to use Tuckman's model to trace the transition from waterfall to agile. Lee used the constant introduction of new team members instead of context, to be the catalyst for the changing environment in each phase. There is a relationship that says collaboration provides understanding, and cross-team collaboration is critical to success.

Agile enhances customer relationships, and the agile focus is on people rather than processes. Xu (2011) felt that Crowston and Malone (1988) only recognize intangible resource dependencies and coordination and ignored the social aspects. The disagreement on social issues was a criticism that may need some further definition from Xu because Malone's (1988) coordination theory was said to contribute to many fields, including sociology and psychology. To truly expand, the definition requires the inclusion of social interactions among participants in the description. The appropriate decision-making structures would have to match project tasks and social context to address coordination challenges, and impersonal communications would supplement these. Individual teams have individual hierarchies that may have different goals and perspectives.

Cross-boundary efforts may facilitate vertical communication. General system theory suggests different units in one organization deal with tasks and establishes their norms, values, and time frames. General system theory believes that various functions can reach the same endpoint through different paths. Inayat and Salim (2015) explored productivity factors from a sociotechnical perspective and found hierarchical network structures harm outcome quality. Vijayasarathy and Turk (2012) focused on hindrances and benefits. They discovered that force-feeding a solution to fit the problem was an approach that was not often successful because organizational mandates that compatibility or fit must meet developer's norms had an impact on workers. The corporate culture plays a role in the adoption and engineering implementation that is influenced by cross-functional team spirit, user participation, and top management support. An organization's cultural environment has both positive and negative effects on adoption.

Critical factors to motivation and innovation included training and self-efficacy, as well as organizational culture and receptiveness to the change and innovation. One finding was that the larger the organization, the more experienced IT developers might have, and therefore the more resistance generated to such a transition. Risk-averse organizations resist sudden changes (Fecarotta, 2008). Drury et al. (2012) agreed with Fecarotta and found that conflict in priorities and competing requirements can often lead to team confusion. Both studies found decisions based on the unstable availability of staff where people pulled from one group to another. One key member removed from the team may result in a team iteration not being completed on time (Drury et al., 2012).

Frustration can result from these team destabilizing factors, and contextual differences can affect decision-making. Some team members begin to rely on others to make decisions, and because of the social nature of agile, some of the results have subtle changes in decisions that may not communicate with others.

In the evolving environment, decisions need to be assigned to clear owners, but all participants must be involved in the decision-making process. These contextual differences affect decision-making and accountability shared by many and may diminish the outcome. Sham et al. (2012) talked about doing different things in a different mindset. Agile evolving can create a better environment where agile appears to be fun and is more exciting and socially motivates team members. Commitment to the change is required to be successful, but it is not easy to convince everyone in every role in any organization. Agile breaks from the norm because mistakes are accepted and build on the ability to learn rapidly from those mistakes to create innovation. Agile learns from previous mistakes through rapid cycle times and provides quick feedback. Adding people to existing teams for creating new ones is counterproductive. Vacant positions should be filled with new members and new motivating roles to allow people to work in different areas instead of doing the same thing for a long time. Agile stories stimulate face-to-face conversations and create an understanding of why the capability is valuable, providing a valuable social interaction opportunity.

A face-to-face conversation becomes an increasingly challenging and less effective way to convey understanding as organizations increase in size. Transferring knowledge eliminates some of the waste in a complex environment and reduces cognitive

overload. Shah (2013) investigates collaboration and coordination that seeks information. Coordination in collaborative project updates and informs laboratories. Different kinds of support affect an alternate form for collaborators to coordinate and change their behavior. Awareness involving learning occurs in a rapidly evolving environment and considers other views. Awareness provides a shared culture where knowledge links to coordination. Coordination connects these groups, which can bring systems under the same set of rules and guidelines.

Innovation and new knowledge go beyond individual expertise and vision by constructively exploring the differences and looking for those standard solutions. Gallardo et al. (2013) found coordination between geographically separated units was impacted by differences in the types of artifacts developed and how to transform those artifacts between groups. Muhammad et al. (2014) found a lack of human resources and impedance to the flow of information that was only surpassed by excess red tape and bureaucracy in the organization. Howison and Crowston (2014) found when crossing organizational boundaries, the imposition of technology has not been able to replicate sociotechnical phenomena worked across space and time. They work using techniques that are a medium of collaboration and draw together partnerships across a set of discontinuities. Brown, Ambler, and Royce (2013) found practitioners needed the opportunity to innovate more freely, and there was a need for a win-win situation where trust is the major component necessary to achieve a win-win.

Gergle et al. (2013) discussed the need to develop collaborative tools with group coordination. Visual information improves coordination by supporting verbal

communications surrounding the activities. Gergle et al. found that low rates of oral discussion, which reduces cycle time and approved processes performance. Conforto et al. et al. (2014) looked at agile project adaptation in industries other than software development and found similar theoretical practices and the need for identification of common goals and objectives. Shah (2013) found agreement with Conforto et al. while investigating the role awareness played in collaboration and shared resources achieving common goals. Snyder (2014) found a similar arrangement when exploring image-making. As a form of social interaction, images play an increasingly important role in communication and collaboration within the cross-boundary disciplinary context. Image-making bridges the gaps in communication.

Pisano et al. (2015) discussed social attitudes in favor of transparency, openness, collaboration, and sharing. The introduction of the trend of global framework and effects on organizations and human behavior, and as the pace of technology advances, transforms the business landscape and organizational infrastructures. The lines between digital and physical worlds have been blurring, and a comprehensive approach now translates these new trends and includes psychosocial behaviors. Dyba and Dingsoyr (2015) discussed self-managing teams in these rapidly changing and uncertain environments, where management roles and practices are also changing. Amici and Bietti (2015) talked about coordination in humans and the facilitation of cooperative behaviors. Coordination and cooperation permeate throughout a multi-layered organization, and within those interactions, their relative impact on a human to human interaction is

significant. A coordinated multidisciplinary perspective primary goal is to provide a better understanding.

Eriksson and Stanton (2015) discuss the need to escalate cognitive activities, which leads to a mental overload or a cognitive overload and creates an urgent need to ensure successful coordination of information can occur. Communication must be considered a critical element in the human systems that can ensure satisfactory information exchange. Dikert et al. (2016) assessed the related activities of human interaction in marketing and product management functions and discovered that adapting to the transformation requires a transformation of the organizational culture and the ability to cross boundaries. A common occurrence during any change and perhaps more so during a full transformation is resistance to change. Resistance to change can take the form of averting the need to move from a status quo to a sophisticated process methodology. Changes to the agile and scaled agile framework are significantly new ways of thinking and can implement mistrust because of their alternative way of evaluating processes, and performance. Management needs to create clear goals such that everyone understands their functionality within those goals.

Lindsjorn et al. (2016) focused on teamwork, quality, and the ability to enable coordination within an organizational restructure. Lindsjorn et al. discussed inter-dependent tasks and collaboration among the team members by the interaction of individual members. A dynamic process reflected in the tendency for the groups to stick together is called cohesion, and cohesion was a significant factor when investigating the influence of team experience and performance capability. Gandomani et al. (2014) found

that any transition to a new framework or transformation that requires adopting a significantly new perspective takes a long time. The behaviors of individuals and the culture of groups evolve many times during the transformation and require a focus on social behaviors and human aspects.

The agile and scaled agile framework transformation employs factors like Deming's (2018) PDCA. The PDCA process helps create a culture of critical thinking and problem solving and is beneficial since agile is about the change in people. Vrhovec (2016) addressed stakeholder resistance to change and software processes. Vrhovec identified a method to adapt to a specific situation to send the real root cause of the opposition. Resistance to change is a natural phenomenon occurring during changes in an organization. IT and communication in the workplace increase resistance because the difference is more noticeable. With the fast pace of technology development and the need for frequent changes to keep up with competitive advantages, the catalyst for resistance to change is present. The more frequent changes are the more likely resistances to recur. These constant changes also affect individual relationships.

Managers normally do not react to resistance, and if managers do respond, management response is usually an ineffective response (Vrhovec, 2016). Management tends to focus on individual levels of resistance, and information systems tend to look at those newly implemented software systems. However, management needs to mitigate the adverse effects of the opposition and to develop a constructive solution (Vrhovec). Management response to resistance occurs as inaction, acknowledgment; rectification; and dissuasion. Inaction usually is due to unawareness of the opposition or its causes.

Acknowledgment responses are limited to acknowledging the resistance, and correction is a response that intends to tackle the issues and possibly address the root causes of the resistance (Vrhovec). Dissuasion attempts to divert stakeholders from resisting. Inaction and acknowledgment increase resistance most of the time (Vrhovec). Rectification and dissuasion have the potential to lower resistance. The best response to resistance is congruent rectification. Butchibabu et al. (2016) looked at interdependence as the link between communication and the goal a reactive communication conveys information in response to a climate change in the environment.

Knowledge management is collaboration, and a means to advance knowledge collectively at the organization and social levels (To, 2016). For social innovation management has an intensive but balanced need to interact with collaboration units. If collaboration occurs, adaptability to evolve and support the social innovation that accompanies change is possible. Waldron (2017) focused on individuals and improved productivity. Individuals working together with clearly structured and shared goals can respond to change more appropriately. Transformation requires rethinking the work environment and how value is perceived. Kudaravalli et al. (2017) studied informal interactions emerging in practice to coordinate different types of expertise. Knowledge workers depend on informal interactions, and the difference between technical and design collaboration matters. Malone and Crowston (1994) introduced the concept of human systems that included the motivations and incentives and emotions of people that are often extremely complex and not well understood. Understanding human systems is an essential part of the coordination. Human systems help us understand computer and

biological systems as well as the direct impact of humans within the transformation system.

The coordination and synchronization of events across a diverse range of interdependent teams become critical to the success and productivity value of any extensive development in agile and the scaled agile framework methodologies. These development systems are highly dependent on hardware and software development tools. Understanding the human-machine cognition interface within those development systems is critical to any possible success. The success of those systems involves the understanding and structuring of an organization to support the human psychosocial understanding and supporting those needs can reduce resistance to change and create a more cohesive work environment that has greater flexibility and adaptability. With the global markets increasing in technological advances and disruptive technology changes within brief periods, change within an organization increases. Since frequent changes have the potential to disrupt an organization to create resistance to change, to cause chaos on the project, team, and individual level, adaptability to change is a critical pillar in the framework of scaled agile framework methodology.

While paying attention to the psychosocial issues that resolve numerous organizational structure issues and creating a work environment that attracts the best employees, businesses continue to focus on the need for competitive advantage and the need to remain a competitive organization within the marketplace. To focus directly on business aspects before having investigated and attended to psychosocial factors is like building the roof of your house before having built the foundation. The final factor or

final pillar supporting the scaled agile framework is the business factor. Many of the previous supporting components of coordination, scalability, and psychosocial factors are intersected throughout the business needs development and discussed in the following section.

Importance of Scaled Agile Framework and Coordination to Business

Billions of dollars are wasted each year on entirely preventable mistakes. Development failures occur far too often. Applying the knowledge about coordination and the vital role coordination plays in transforming a business into a successful and competitive organization becomes more critical as the rate of change increases (Xu, 2009). Besides, we have seen many psychosocial relationships that directly affect business outcomes and organizational efforts to transform into a scaled agile framework (Dikert et al., 2016). A scaled agile framework supports scaling small and medium business development to large-scale development that has become prevalent throughout the business and has become a significant competitive advantage. With many organizations failing to transform into large-scale agile development, there is difficulty understanding why so many organizations do not see preventing these failures as a priority (Charette, 2005). IT is one of the most significant expenses, and investments in large-scale projects constitute a substantial investment of time, resources, and dollars. The technological advances and ability to leverage these advantages become a significant competitive edge for any organization that can achieve the transformation to the scaled agile framework (Lee, Park, & Lee, 2013).

It is the conundrum that the more complex these large-scale efforts become, the more likely the projects are to fail. The incredible interaction between hardware, software, and humans create greater complexity and increases the probability of error. Charette (2005) explained that large-scale projects are more likely to fail than small projects by over a 300% increase in failure. Rao (2015) looked at the high failure rate as something we need to develop a healthy habit from which to learn, and Inayat et al. (2015) found customer involvement and interaction as the reason for colossal failures. Projects of this size have so many software lines that a mere couple of incorrect lines can cause significant time, dollars, and resources to repair. There is a tendency to look directly at the programmers and engineers to look for the causes of any failures (Lee et al., 2013). In this instance, the transformation to the scaled agile and successful execution of large-scale development integrates into the entire organization. Management has a vital role in successful transformation, and management has numerous opportunities to create an inhospitable work environment that increases turnover, withholds adequate training, and does not understand the basic principles that make the transformation successful.

The organizational environment must include a focus on culture, communication, and coordination, to reduce or avoid potential mistakes that may occur early in the process and avoid large amounts of rework. Organizations that are unwilling to learn from these mistakes suffer IT failures and may cease to exist after one or two significant failures (Charette, 2005). Turk, France, Robert, and Rumpe (2005) investigated the assumptions underlying agile software development. Turk et al. found some assumptions

did not apply in all software development environments and all organizations or work environments. Some of these assumptions were not aligned or directly conflicted with those of the organization, and management must change the development need to adapt to the development process. Wirth (2008) reviewed the software engineering history to determine how we got to 2008 and what we could learn to avoid future missteps. Software and hardware alternated the lead in capability; each had to catch up with the other. Many different methods were employed, and many of these worked for a short while. Eventually, software developers built a more systemic development process, and engineers began to distinguish between business strategies and scientific ideas. The massive increase in hardware opened a vast and diverse spectrum of opportunities for business and opened growing complexity. Engineers began to investigate methods that could optimize output. As work began to increase, time pressure became a significant obstacle. As time pressure continued to be a considerable obstacle while searching for a means to optimize outputs, the result was inefficient code in decreased quality or reliability of the software.

Vijayasarathy and Turk (2012) understood engineering implementation influenced cross-functional team participation and top management support, and Maples (2009) recognized that agile allows flexibility and realized that transformation is a continuously ongoing process and that change is difficult. Internal conflicts within the organization were understood when, even with flexibility allowed by agile methods, there were specific fixed standards within the organization related to the release of any commercial product that became a wall that developers had to overcome. Without

coordination, teams must decide what new things to work on for themselves, and there can be a significant disparity between different groups. Differences can become challenging to expand a scaled environment where part of the organization has not yet adapted and begun to work in agile environments.

Culture becomes a substantial risk during transformation. A constant adaptation becomes a significant factor during the transformation and development of an agile culture. Development teams become self-managing while the business department supplies fixed dates to deliverables in a different work environment causing friction between the major departments. If the dispute becomes a routine battle between engineering and business departments, the agile culture could quickly begin to erode. Underlying the friction is a trust factor that causes teams to falter, causes efficiencies to drop significantly, and ultimately causes failure of the entire project. Culture becomes a critical factor in the success of transformation to a scaled agile framework. The culture must have trust as a crucial component, and there needs to develop a partnership with executives, training, and multiple development groups.

Booch (2007) focused on the transformation and the understanding that manual labor is ultimately the function of the development team that yields quality. Quality is essential because the amount of rework can be a value equal to 50% of the actual project. Rework results in extensive overages of both cost and schedule and can lose the competitive edge and ultimately cost the business significant revenues. Lee (2008) talked to some of the changes that affected senior management. He used the Tuckman model to analyze the transition from waterfall to agile during the development. During the

storming phase, some of the issues occurred because the perception of developers that breaking down an activity into tasks can complete in one day was not possible. The concept of business value and prioritizing tasks associated with higher value was also a new concept that required the ability to discuss and understand the meanings of these new concepts. Teams would have to transition through behavior adjustments in the norming phase and eventually realize that collaboration was critical to the performing period. The alignment of the work environment and organizational infrastructure would occur during the performing phase and would have to align so that there was mutual support from each function. Concept of working as a team and collaborating provides understanding and is critical to organizational success.

Soundararajan and Arthur (2009) looked at complex changes to the large-scale environment and how the system's evolution would adapt to these environments. Agile focus is on people rather than processes and is a principle of the Agile Manifesto. In organizations where command-and-control leadership has been the method for many years, agile can cause great confusion and disruption. Conflicts occur where agile fosters the ability to accommodate to change requirements in direct opposition to the philosophy where large-scale systems would require a structured approach. Often a hybrid approach would be put in place to smooth out a transitional obstacle. Xu (2011) looked at the business environment and the disruption caused by technology changes. The rapid changes in technology and business environments caused a greater need to advocate agile methods, and the aim was to increase customer satisfaction, eliminate waste, and to lower defects.

Sharing, characteristics such as iterative processes, incremental development, self-organizing teams, dynamic interactions, and communications, and reducing resource-intensive tasks is part of the transition to agile and scaled agile framework (Xu, 2009). Scaled agile framework transition does not occur without some disruption to the organization. Effective coordination is critical for the development process to adapt to the transformation. Some coordination mechanisms used to help the transition are daily standups, co-located teams, code ownership, synchronous planning, and iterative planning sessions. An added perturbation to coordination processes is that these mechanisms employ an informal management style. Coordination challenges occur in large projects and include lack of interaction between participants, miscommunication, loss of knowledge, requirements instability, complex tasking, and technical complexity. Guzmán et al. (2010) explored the integration of strategic management and process changes in software engineering organizations. The combination of management and improvements had to obtain a competitive edge in the software engineering organization.

Strategic management is a crucial discipline to support companies' ability to meet competitive goals, and the management strategy increases improved competitiveness. Study findings identified the necessity to define a plan in terms of objectives, not lose the vision of the organization, and the constraints of the organization's interaction. Strode et al. (2012) investigated adaptation effects in the organization and coordination achievement. There is a relationship between coordination strategy and project coordination. Knowledge management defines how coordination supports transferring current knowledge and transforming to the new methodology as large-scale projects

create highly interdependent teams. Coordination helps these highly independent subunits, and boundary spanning provides a method to align with external groups and to coordinate activities. Vijayasarathy and Turk (2012) found there were often organizational mandates on how developers worked, and corporate culture played a role in how these mandates are adopted. Engineering influenced a cross-functional team spirit, user participation, and senior management support. These findings recognized the convergence or the nexus of some critical factors instrumental in the adoption of these new methodologies.

The organization's cultural orientation concerning innovation can have a positive or negative effect on the actual transformation. The organization's culture and receptiveness to change and innovation is critical to the transformation. In a larger organization, change is harder to facilitate because of the organization's structure and culture. Drury et al. (2012) looked at some of the decision-making obstacles in the transitional environments, some of the essential findings or the teams face barriers such as lack of information, lack of participants, and team members' interaction. Sometimes poor decisions are made based on personal interests in a project, and some of those may undermine the ultimate success of the project. The agile and scaled agile framework development teams work under extreme time pressures to deliver working software in short cycle times. Here teams need to use retrospective feedback to make sure the tactical decisions and short-term improvements are positive or, if necessary, improved. The team's willingness to commit to a decision is another key obstacle to the transformation. Any lack of commitment causes serious negative impact because there are conflicting

priorities for decisions, and teams compete for priorities. Other times there are contextual differences based on team composition, and expertise and some team members rely on other team members to make the decisions. Decisions must be made clear by owners, but all team members should be involved in the decision-making process.

Sham et al. (2012) examined the mindset of approaching an innovative organization and using agile methodologies. Maranzato, Neubert, and Herculano (2012) focused on the scrum process in the transformation and focused on new business. Independent groups can choose the tools to use the following agile goals of individuals over methods. There is a challenge to be sure teams are working on the most valuable activity for each product. The term value has a specific meaning within an agile and scaled agile framework and may have different perspectives between the teams and management perspectives (Knaster & Leffingwell, 2017). Teams cannot take a low-value activity and create a higher priority based on their perception of the event (Drury et al., 2012). As groups change personnel, new value or new knowledge alter the group's understanding. Team commitment is identified again and shown to be an essential factor in the process where agile gives value to commitment, transparency, and teamwork (Maranzato, 2012). Good communication and coordination between members, both internal and external, are critical. The principle of continuous improvement needs to become the team's objective, such that the team suggests improvements (Waldron, 2017). The transparency of the units allows all attendees to have an opportunity to bring up new topics, which can increase the level of synchronization among the teams internal and external.

Read, and Briggs (2012) looked at evolving designs within transforming organizations to large-scale complex projects. Read and Briggs identified face-to-face conversation as a very positive function and part of the more extensive social interaction required for successful projects. As projects get larger, the personal interface's ability becomes more complex, and understanding and analyzing becomes a more significant challenge. As the size and complexity of the projected increase, the obstacle to understanding makes knowledge transfer more difficult. Turner et al. (2012) explored the effectiveness of the Kanban approach in systems engineering and these transformational environments. Kanban operates on cadence, the ability to move work and to monitor the work in process, but activities design at requirements and schedules. While Kanban operates on rhythm, standard engineering methodologies operate on a schedule, and the two do not necessarily synchronize. Fortunately, Kanban does not require an organizational structure, and these projects can be set up and allowed to evolve into the desired result. Huang, Darrin, and Knuth (2012) looked at the disparity between agile implementation and software projects, but not in the hardware systems engineering components of those projects. The agile systems engineering facilitates the momentum that allows innovation in the development process and manages risks incurred during the transformation.

The ability to innovate becomes related to the speed of the development process and allows continuous change. Projects require extensive development and nonrecurring engineering, which makes requirements hard to determine, and affects the many changes and interactions that occur with the customer during the project (Huang et al., 2012).

Transformation to agile and scaled agile framework follows a similar pattern identified by Deming (2018) and known as the PDCA process. The flexibility of the team allows the reaction to external pressures, and adaptability is the response of the system to internal demands. Systems engineering needs flexibility and adaptation but must be agile's approach to management and systems engineering. Shah (2013) investigated how awareness affects the ability to have coordination. Coordination updates and informs collaborators about the group's status and the future direction of the group. Awareness knows who was around, what activities process, and others' views within the work environment. Awareness helped to create a shared culture as knowledge links to coordination.

Coordination is an essential part of the collaboration, and infrastructure and environment are positivity affected by agents that work together with one another (Gallardo et al., 2013). Gallardo et al. looked at collaborative models and applications and found cooperative units can facilitate the execution of the business processes in collaboration between geographically separated groups. Different units may be processing various artifacts, and the transformation between objects can add an extra layer of complexity (Xu, 2009). The transformation process is between artifacts of different domains and must represent a universal language. Shared information helps achieve common goals, and graphical elements to facilitate understanding between disparate groups. Amici and Bietti (2015), Conforto et al. (2014), and Hui (2013) looked at the uncertainty in organizations attempting to transform into large-scale development. The implementation of lean became a significant factor in agile transformations, and

organizations turned easier when lean (Saeeda et al., 2015). One of the findings from the study was that organization outcomes were better during transformations if focused on learning their way to success. Introducing change to the organization without buy-in at all levels fails (Hui. 2013).

Muhammad et al. (2014) studied the effects of communication on the logistics system and found a lack of information dissemination about IT and associated that with missed opportunities. The study included looking at the communication methods used, which method was highest rated, and which one was most effective. The expected finding was that the right communication method would enhance the efficiency and fixed many of the current problems in the communication channels. The conclusion was the best method for communication was the computer and the Internet was a subset of the computer. Organizations adapting to agile and scaled agile framework methodologies benefit from the study of Muhammad et al. and its finding that the two things that affect the communication system the most are extensive red tape and growing bureaucracy. A lack of human resources was a very close second highest obstacle. Rapid changes in technology increased communication issues.

Howison and Crowston (2014) looked at a very tangential perspective called open superposition. The open superposition perspective was a significant tangent from coordination and projects as practiced in the norm. Open superposition was a natural evolution of the sociocultural, technical phenomenon where crossing organizational boundaries crossed multiple lines of national boundaries of culture, and aligned work is undertaken by individual members in smaller layers and then integrated the intricate

layers to create the product (Howison & Crowston). The online shareware built by large numbers of people from around the globe that have never met each other write portions later integrated into the product. The developers are all talented individuals that volunteer their expertise, and the transparency in the process allows volunteers to engage in these activities quickly (Howison & Crowston). Participation in the open superposition method provides a need to satisfy competence, providing autonomy, and introducing collaborative action through the open superposition of the community-based projects (Howison & Crowston). Within open superposition methodology, individual members build on each other's work without relying on each other's future availability (Howison & Crowston).

These software developers provide spontaneous support on tasks that are relatively short and may not lead to the final product. For them, the goal is to see the finished product (Howison & Crowston, 2014). Modularity is the descriptor of how the code is characterized into layers and becomes the product. A coordination theory framework works in the modeling of those participants performing these activities. Uncertain that there is a reward is less relevant because of the volunteer work, and volunteers look for the functionality. Obstacles occur on more complicated operations, and other volunteers can perform independent work layers while the barriers get resolved (Howison & Crowston). The diversity of those providing support often provides optional value not identified at the beginning of the activities. Constructive feedback loops on both sides increase the functionality and drive the development of new ideas. The

openness provides better conditions for a collaboration environment (Howison & Crowston).

Bass (2013) found that teams' ability to use agile methods to scale up to large international projects was steadily increasing. From the development perspective, there was difficulty making decisions about requirements when a product owner was absent and suggested that agile methods scale up to large projects. Brown et al. (2013) saw that some groups became resistant to change and polarized while others were quick to adapt and subsequently demand others to adapt to change. Groups that ushered others to adapt appears at first to be very positive, but groups polarize into those who are accepting change and those who are pushing for others to accept the change. Where transforming some see change as a problem for their local effort and as a challenge to their status. Vijayasarathy and Turk (2012) agreed the larger their organization and the more experienced the developers, the more resistance there may be to the transition to agile, and Fry and Greene (2007) suggested that involving individual contributors can reduce the resistance. Larger businesses may immediately focus on the transformation to create an efficient and profitable organization. Different teams misaligned with the organizational goal in the adaptation and transformation stalls due to the misalignment. Agile was for a small co-located development group, and the more complex environment requires an enhanced focus.

During the transformation, these challenges need measurement in a systemic manner where team size, domain, complexity, and distribution are all considered equally (Brown et al., 2013). The organizational structure of its culture and financial challenges

interact during transformation. While the organization is focused on transformation to improve economic outcomes, the transformation requires a major cultural transformation. According to Brown et al., teams must be able to innovate freely and require the development of a solution where everyone benefits. A significant component of any solution where everyone benefits is the organization's ability to achieve trust. Gergle et al. (2013) saw that a rapid increase in the organizational structure created changes along with the technological advances and new work formations, which added to the complexity of the work environment and caused a rise in failures. A contributor to these failures is those not developing collaboration tools with enough knowledge of how the groups would work and coordinate activities (Vrhovec, 2016).

Conforto et al. (2014) investigated agile in organizations that were not software development organizations. Conforto et al. found agile reduced complexity, and evolution occurs that creates changes that result in barriers to the implementation. The less formal process of agile supplies the team with enough autonomy to make decisions, and teams can merge or blend the transforming organization with the implementation of agile.

Malone (1988) proposed that coordination theory can focus on problems that have been previously considered separately in different fields and find the commonality, which result in innovation. Pisano et al. (2015) looked at innovation in businesses and supported Malone's idea on innovation. Pisano et al. determined that socioeconomic as well as technical trends were changing the environment and creating new opportunities, new business, and new challenges. Pisano et al. found that innovation could often be the result

of two diverse industries working together and creating a new concept. The social attitude that favors transparency, openness, collaboration, and sharing is required in teams transforming to roles where working together to create products and services that are new. New trends in the global framework of business affect organizations as well as human behavior. These new trends must be defined in terms of social, technological, psychological, and economic features where organizations must react to customer needs and quickly find new solutions.

Geographically separated and diverse functional areas of businesses are now linked and related and must communicate with each other to perform value development for customers (Inayat & Salim, 2015). Businesses must continue to exploit technological innovation to avoid missing opportunities, to create value, and new technologies in the marketplace. The transformation methodologies model methodologies are based on a holistic approach that transforms new trends that occur where digital and physical worlds begin to blur. Inayat and Salim (2015) looked at an agile team as a sociotechnical system and focused on the information flow and exchange and tendency to increase communication within the work teams. The Inayat and Salim study found collaboration in agile teams being visualized through the perspective of the participants involved in the transformation. In an agile development there is constant change and constant collaboration is essential for success.

Rao (2015) tied knowledge to learning and a learning culture. Rao found the need to build bridges between knowledge management and data analytics by thinking outside the box. People need to have the freedom to express themselves in creative ways that

allow knowledge to be captured and to be communicated. The freedom to express themselves includes simple doodling or drawing and random even stick figures to capture and transfer ideas. Gill (2015) looked at the adaptation or adoption of agile in large-scale environments. Gill also focused on the need for education in software engineering at a large-scale environment and included people, processes, social, and technical aspects. Coordination and collaboration are primary keys to success during transformation. Not only is transformation to large-scale agile framework complex and difficult, the teaching of adaptation practice is a non-simple task. The ability to scale learning to student projects in teaching environments becomes a major challenge for the education of large-scale software engineering in a single semester, as is the transformation to a scaled agile environment in a very short period, and both are major challenges to the organization.

Large-scale enterprise practice increases complexity at all components of its conceptual framework. Just as in the actual organizational enterprise, projects are not done in isolation and frequent communication, standup meetings, and retrospective analysis is required. Brenner and Wunder (2015) investigated multiple teams attempting to align to provide common value for their customer and like Gill (2015) these team meetings are synchronized to increase the communication and coordination between the individual team activities. Scaled agile framework reduces the coordination complexity and provides a common goal and commitment for participants. Lee, Park, and Koo (2015) found that individuals are more cognitively connected when their job is perceived to be fulfilling. Employees psychologically relating to their job having an organization identity positively correlate with individual attitudes associated with organizational

identity. Inayat et al. (2015) sought agile methods to replace the conventional requirements documentation with concise user stories with focus on system quality. New interaction and team collaboration reduced communication lapses and simplified the knowledge transfer as the requirements documentation was replaced in the transformation to agile. Inayat et al. found there to be a problem to only focus on business value and to allow customers to prioritize requirements. This statement that is was a problem to only focus on business value is different from the other studies and needs to be explained in more explicit terms not to create conflict between the concept of business value as pertains to agile and scaled agile frameworks.

Saeeda et al. (2015) looked at the limitations that occur when scaling smaller projects to large-scale efforts. Saeeda et al. found less empirical data on the scrum technique in large-scale projects. The difference in empirical data was found to be knowledge that was missing between the research and the implementations employing scrum. Increasingly complex products lead to increase complexity and greater risks. Some of the main reasons for project failure are the inability to create a smooth adoption process, lack of enough support and limited financial and human resources. Ghani and Bello (2015) focused on adoption in its ability to speed delivery and improve quality. Adoption is a focus on the ability and responsiveness to change. Perhaps the greatest barrier to adopting change is organizational culture. A critical goal success factor is the team environment. Functional areas are influenced by the organizational culture and especially by executives. Executives' lack of knowledge of the agile methods and of the benefits are major constraints in the transformation.

Dyba and Dingsoyr (2015) looked at self-managing teams. These projects tend to be unique and difficult to plan while being required to continually evolve. Teams need to be cautious not to extrapolate past trends as the sole means to adaptation. Because complexity is added to the fast-changing uncertain environment, there are accompanying changes in management roles and procedures. Metz et al. (2015) investigated the online whiteboard as a tool of coordination and synchronization. Synchronization of the different functional areas requires multiple disciplines to work together to become a collaborative to perform a task with common goals. Synchronization requires the integration of social, technical, and organizational aspects. The human dimension involves the integration of cognitive and social processes, which include knowledge skills. Eriksson and Stanton (2015) looked at the importance of communication for successful coordination in these complex systems. Systems are becoming more complex and need to escalate the cognitive activities. When cognitive activities continue to escalate, and requirements exceed capacity mental overload can occur. When cognitive activities continue to escalate, the mental overload requires an urgent need for successful coordination and collaboration of information between systems.

Communication is vital for the transfer of knowledge and information and supports successful collaboration and coordination of projects. Dikert et al. (2016) reviewed the literature on agile transformations and found that agile projects tended to increase in size and complexity. Coordination has expanded to include greater detail and to understand the activities related to humans within that system (Brenner & Wunder, 2015). A system view in earlier studies and a holistic approach established the method

required for successful transformations. They are adopting new methodologies that required transformation of the organizational culture and the ability to cross boundaries (Brenner & Wunder). Management and business functions are affected by the transformation as much as the development organizations. The transformation can uncover some conflict between long-range business planning in the short-term iterative cycles of the agile methodology (Dikert et al., 2016). Transformation requires more than just change. Transformation requires reinventing social, as well as technical processes and methods, as seen in previous articles (Dikert et al.). Resistance to change is reasonable, and in complex transformations, it is critical to understand that resistance occurs and, when well-managed, can help smooth the transformation (Vrhovec, 2016).

The scaled agile framework is a new way of working, and people are skeptical, leading to distrust and potential resistance to change (Dikert et al., 2016). Dikert et al. also stated that in a transformation, the disruption is enough for people to be suspicious of the process and concerned about their security within the changing system. Not everyone wants to change, and not everyone is comfortable with their new roles and responsibilities resulting from transformation. People are unwilling to change unless there are good reasons clearly understood, such that the change is perceived to be relatively easy and beneficial (Dikert et al.). As seen throughout the literature as multiple teams with multiple cultures, various agendas, and various goals coordinate activities toward a central goal, conflict arises as each group attempts to instill their culture and goals on the other teams. Data documented suggests that coordination is a primary requirement for successful transformation (Gandomani & Nafchi, 2015).

Kim, Banks, and Shah (2017) and Salo and Abrahamsson (2008) used an experimentation method. Gandomani et al. (2014), Gentles, Charles, Ploeg, and McKibbon (2015), and Jovanović, Mas, Mesquida, and Lalić (2017) were three studies that did not use the case study method. These studies attempted to use a grounded theory approach to develop a framework for agile transition and adoption empirically. One of the tenants of their research was that transition is difficult and requires a substantial organizational overhead. The transition to the scaled agile framework and adoption of the new methodology takes a long time, and the transformation affects every aspect of the organization and becomes a continuous evolution of the software process. The process must include the collaboration of the developers, engineers, management, and customers.

The transformation also requires significant changes in the organization's behaviors and cultures. The transformation includes new processes, people, management, culture, and technical issues. In my study, business values are considered the core component, and focus emerges as a business value that requires clear goals. The transition must facilitate and achieve business value (Gandomani & Nafchi). The transformation cannot be achieved overnight or within a short time. Transformation follows a model like the Deming PDCA, which may facilitate the transformation because Deming's PDCA is a well-known concept (Deming, 2018; Vrhovec, 2016). A critical idea to remember is that the transformation includes people, and people can be the most challenging part of the system to change. Employing the PDCA model fosters critical thinking and problem-solving as a transition proceeds as a continuous process (Vrhovec). Vrhovec explored the thought process on resistance to change in software projects. The

large projects increased complexity, and participants had a natural tendency to become skeptical and insecure during the transformation, which fosters potential resistance to change. As the organizational structure responds and evolves to the transformed work environment, frequent changes occur, and a higher number of changes tend to increase resistance (Vrhovec). From the psychosocial perspective, as the organization changes and the processes change, the effect is not only the means and flow of the work but also the relationships between individuals within the work environment (Lee et al., 2013).

Managers do not necessarily react to resistance because managers are looking at a more individual level of resistance (Vrhovec, 2016). Change meets with responses that include inaction, acknowledgment, rectification, and dissuasion. Inaction is often due to the awareness of resistance or inability to respond (Vrhovec). Acknowledgment recognizes the resistance but may not do anything else. Rectification intends to problem solve the issues. Dissuasion attempts to prevent the resistance through coercion, authoritative persuasion, or supportive persuasion inaction, and acknowledgment only increases resistance. Rectification and dissuasion have the potential to lower resistance, but the best response to opposition is congruent rectification (Vrhovec).

To (2016) looked at knowledge management concerning organizational learning. Knowledge management views collaboration to advance knowledge at the corporate and social levels. Collaborating these interactions provides an orderly flow and structure to help resolve difficulties in the communication system. A new shared meaning from the transformation requires cooperation between the teams in an innovation context. The social innovation must balance the collaborative units' interaction to facilitate

adaptability to evolve the organization. Dingsoyr, Faegri, Dyba, Haugset, and Lindsjorn (2015) looked at factors influencing the co-located team's performance, and their key findings included establishing a shared mental model in the team. Knowledge work lives in an innovative environment where social interaction provides a shared context and where coordinating team members are vital to project success. The ability of the team to adapt to change in a technological environment becomes critical. Product quality feedback is related to performance, and team coordination involves creating a shared understanding for all members.

Coordinating work processes and procedures provided mechanisms for rapid feedback to all team members (Xu, 2009). Synchronizing the activities that require coordination is a key aspect. Administrative coordination, for instance, includes budgets, staffing, analysis, milestones, and review meetings. Dingsoyr et al. (2016) supported Xu's perspective that within these coordination efforts providing frequent feedback helps performance. Waldron (2017) focused on individuals to improve productivity. In agile working together toward a clear, shared goal provides a better response to the change. Transformation to a scaled agile framework involves the need to rethink the physical working environment.

Alahyari et al. (2017) attempted to see how the value was perceived. The understanding of the term value requires knowledge of lean methodology, which states that all activities and work that does not directly contribute to the value of the product are considered waste. Within the transformation, to scaled agile framework, one of the most accepted practices is continuous integration and delivery was considered the most valued

artifact from the transformation. Some participants prioritized perceived quality, and all valued the on-time delivery. Kudaravalli et al. (2017) looked at the transformation to agile methodologies and potential bottlenecks. The decentralization for coordinating expertise among the teams was presumed to reduce bottlenecks. The team approach provided structures that considered variance across time and different organization types. The team approach provided informal interactions in the coordination of different kinds of expertise supporting knowledge workers who depend on informal communication. Orlowski, Ziolkowski, and Paciorkeiwicz (2017) identified the business environment as dynamic and characterized by rapid change, complexity, and uncertainty. Technology and progress in lowering political barriers create the possibility for people and organizations to work almost anywhere anytime.

Employing the application of knowledge, skills, tools, and techniques to project activities ensures successful address meant addressing and handling of dynamic changes. The business environment of customers and organizations is in continuous evolution, and organizations' structures must change and adapt to these dynamic market situations. Malone and Crowston (1994) realized the necessity to understand the transforming organizations and coordination that was about to unfold on organizations. While necessary to understand information technology, understanding the human organization was equally important. Coordination and human systems provide the ability to understand computers, or as von Bertalanffy would support biological systems. Malone and Crowston defined coordination as managing dependencies between activities. The human system may involve incentives, motivations, emotions, and cognitive processes that do

not exist in the technological system; however, both systems have similarities and differences. One of the most important differences between those two systems is that the issue of incentive motivation and emotions are the concern of human systems. One of the coordination theories' concepts was that ideas could be transposed back and forth across disciplinary boundaries where opportunities evolve. In the transformation, group decision-making processes provide alternative ways for the group to make decisions, create new alternative coordination processes, and new ideas.

Communication and coordination processes consider alternative forms of communication and provide new ideas and innovations (Malone & Crowston, 1994). Coordination in human organizations can be obtained simply by asking others what their goals are and then to evaluate in terms of a standard or shared criterion (Malone & Crowston). These interactions also cause conflict and may occur where the goal supports one individual team at the expense of another, and ultimately the Malone and Crowston (1994) interdisciplinary study of coordination has become a global adaptation issue. The solution to organizational adaptability and transformation to the changing global and business environment is an evolutionary process (Soundararajan & Arthur, 2009). It requires the teams that are now struggling to transform the scaled agile framework to the same organizations that change to whatever methodology evolves in the future.

Synthesis and Summary

Most of the research on agile and scaled agile framework focused on large-scale to scalability, communication, collaboration, and coordination; psychosocial influence; and the importance of scaled agile framework and coordination to business. Several

researchers investigated the coordination methods required within a systematic organizational transformation to high complexity development processes. Each researcher identified that there is little understanding of how to achieve effective coordination (Amici & Bietti, 2015; Dikert et al., 2016; Strode et al., 2012). Amici and Bietti (2015) utilized the contributions from cognitive psychologists, computer scientists, primatologists, and others to focus the multiple perspectives on coordination to better understanding low-level processes driving coordination. Dikert et al. (2016) investigated success factors, and coordination identified as part of a group of factors. The finding was that large-scale projects needed additional coordination. Strode et al. (2012) found there was little understanding of the coordination of how projects achieved coordination. My study focused on coordination in a scaled agile framework environment and endeavored to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework.

Summary and Conclusions

Businesses are continually under pressure to develop more complex products, in a shorter time, at a lower cost, and with higher quality. Global competition continues to create the need for innovation and adaptation to rapidly changing technologies. The large-scale projects and time pressures force organizations to become more flexible and adaptable. Transformation to scaled agile framework environments requires organizational changes that impact the psychosocial factors affecting the human systems in the organization. The transformation includes restructuring of the organization, implementing new agile methodologies, cultural transformation, and changes to roles and

responsibilities. Successful transformation provides the organization with a competitive edge in the marketplace and secures employee positions. Large-scale projects' complexity requires a coordination process that synchronizes the production cycles in the organization and creates a shared vision for the product developed.

Fry and Greene (2007) accomplished a case study on large-scale agile transformation and cited a problem at the time of the study that there were no interconnectivity or feedback mechanisms to support cross-functional coordination. That statement is supported by several other studies that identified the dynamic change occurring in the organizations and the processes. Dyba and Dingsoyr (2015) looked at self-managing teams, and found projects tend to be unique and challenging to plan while being required to evolve continually. Vrhovec (2016) agreed with the evolution of change, adding that as the organizational structure responds and grows to the transformed work environment, frequent changes occur, and a higher number of changes tend to increase resistance. The literature agrees that as projects become large-scale the complexity increases, change becomes dynamic, and the entire environment must become flexible and adaptable, as evolution becomes a driving factor.

Combining the general system theory and the coordination theory provided a conceptual framework that captured the system view as well as the internal coordination structure of the transformation. The conceptual theories for my study provided an external view of coordination from the perspective of the system and an interior view of the coordination process from the team perspective. The business represents the combined perspective of both these theories. The application of the two theories

uncovered four areas that business organization needs to align to achieve a successful transformation: scalability; communication, collaboration, and coordination; psychosocial factors; and business transformation.

The purpose of this qualitative exploratory single case study was to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework. Strode et al. (2012) identified coordination as critical for the success of agile processes. Amici and Bietti (2015), Dikert et al. (2016), and Strode et al. (2012) investigated coordination methods required within a systematic organizational transformation to high complexity development processes, and each found that there is little understanding of how to achieve effective coordination. The gap in knowledge of coordination that supports transformation to the scaled agile framework and the need to explore this facet of transformation makes an exploratory case study design a vital choice. New knowledge gained from this study can show the relationship between coordination methods and a successful organizational transformation. The study findings contributed to a successful transformation and reduced development failures. Chapter 3 includes descriptions of the research design, methodology, participant population, data gathering process, and analytical process for the study.

Chapter 3: Research Method

The purpose of this qualitative exploratory single case study was to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework. My study was a qualitative single case study to explore the contemporary phenomena of scaled agile framework transformation from a holistic perspective in a natural setting of a large organization (Yin, 2014). Stake (1995) said data gathering occurs primarily in the participant's environment, and I spent significant time in the participant's environment per Stakes comments about being in the participants' environment.

This chapter contains an explanation of the research methodology, including research design and rationale, participant selection logic, instrumentation, procedures for recruitment, participation, data collection, data analysis, and issues of trustworthiness.

Research Design and Rationale

The research question was, how does a large organization transforming to scaled agile framework use coordination methods to support software and systems engineers to potentially improve the success of the implementation of the scaled agile framework? The research question was intended to drive the research and analysis toward a better understanding of the role of coordination to improve transformation efforts for large-scale development.

An exploratory case study design was employed to increase the understanding of the role and relationship coordination in the transformation. The case study provides a comprehensive understanding of a case and helps the reader examine the case so he or

she can learn from it (Stake, 2013; Yin, 2016). The key to case study research is identifying the case and setting the boundaries of that case (Merriam & Tisdell, 2015). Based on the research question, I determined the methodology used. The research method aligned with the research problem and purpose. An exploratory case study answered questions focused on understanding or explaining who, what, where, how, or why.

The research was qualitative and consistent with the criteria. Several researchers have investigated the coordination methods required within a systematic organizational transformation to high complexity development processes, as described in Chapter 2 (for example, Amici & Bietti, 2015; Dikert et al., 2016; Strode et al., 2012). Researchers have consistently noted that there is little understanding of how to achieve effective coordination.

Research Design

Qualitative research enables social researchers to investigate phenomena in natural environments, involving several methods of data collection where data emerges within the process and is mainly interpretive and holistic (Simon & Goes, 2013). Qualitative data are raw and unstructured in the form of notes, transcripts, interviews, emails, and visual artifacts. The feedback loops in Figure 2 represent the need to collect and analyze data simultaneously. The resultant design emerged from iterative processes and continuous feedback loops (Merriam & Tisdell, 2016).

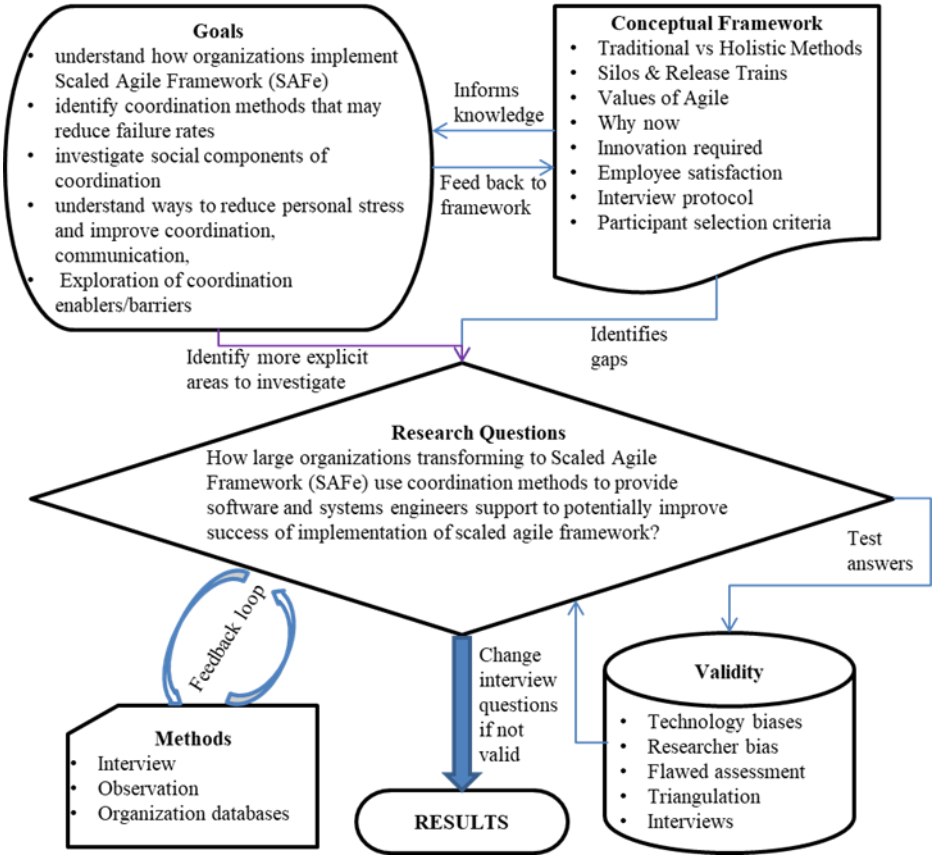

Figure 2. High level perspective design map. Adapted from Maxwell (2013, p. 9).

Qualitative research sees the world in terms of people, situations, events, and processes connecting these actors (Maxwell, 2012). Some of the goals of the qualitative study include understanding meaning, understanding the context where the actors reside, understanding the process where events and actions occur, identifying anticipated phenomena and influences, and developing causal explanations (Maxwell, 2012).

A qualitative research design is generally used to study a complicated situation where little of the subject is known, to study actors in natural environments, and to understand the why and how of the actions (Merriam & Tisdell, 2016; Maxwell, 2012; Stake, 1995). In accordance with Simon and Goes (2013), I used interviews, field notes

as a casual observer, and historical organizational data to triangulate the data and apply an interpretive and holistic approach to the subject.

Gordon, Blake, and Shankaranarayanan (2013) explored the agenda for future case studies, consistent with Stake's (1995) concept of the context of the environment. Gordon et al. found case-based research a primary method to explore human resources. Hancock and Algozzine (2011) agreed with Stake that the primary goal of a qualitative study is to understand context and environment. My exploratory single case study focused on a global aerospace company that is transforming a bounded group from the waterfall methodology to a scaled agile framework. The study occurred in the group's natural environment. Yin (2014) defined a case study as a logical method where the research questions are why or how when there is limited control over participant behavior, and when a contemporary event is the focus of the study. When there is a need to understand a specific phenomenon better and study the phenomenon in a systemic context, the case study was a solid research choice (Yin, 2014). The exploratory case study approach aligned with the logic of the research and was the best choice for data gathering and analyses.

My research design required participants to provide details of evolving transformation within the context of the participants' specific environment (Hancock & Algozzine, 2011; Yin, 2014). The interview participants came from within the system, who were involved in transforming a scaled agile framework in a bounded system that the researcher did not control. A better understanding of the critical coordination methods required to complete the transformation successfully offered opportunities to explore and

identify factors that contribute to high failure rate of development projects. An exploratory case study was the most logical approach for identifying and analyzing coordination methods that helped better understand how a large organization transforming to the scaled agile framework used coordination methods to support software and systems engineers to reduce failure rates that approach 70 percent.

This study was an exploratory case study to explore a single project team with multiple functional teams using coordination methods. To create the design for my research a graphical framework, or concept map (see Figure 2) explains what was studied, the key concepts observed, and the interrelationships among the concepts.

Research Rationale

The purpose of this qualitative exploratory single case study was to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework. The selection of a qualitative study was compatible with the goals of the research question (Maxwell, 2012). The thorough perspective obtained in qualitative research that allows the development of an open and structured collection of data. Qualitative research is considered subjective and occurs in the natural environment using a holistic approach (Simon & Goes, 2013).

Six strategies for the research design identified by Merriam and Tisdell (2016) were basic qualitative research, phenomenology, ethnography, grounded theory, narrative inquiry, and case study as possible methods. Basic qualitative research believes that knowledge is the result of people engaged with an activity or phenomenon (Merriam & Tisdell, 2016). There is a primary interest in understanding the meaning of an event in the

study. My study did not focus on the people engaged in the activity of scaled agile framework transformation. The study focused on the method being used by those people to facilitate the transformation and outcome. Therefore, the basic research approach failed to meet the criteria.

Phenomenology focuses on experience and how experience transforms into knowledge (Merriam & Tisdell, 2016). Efforts to simplify and reduce phenomena laws are the focus of phenomenology. Phenomenological methods are focused on the experience and often specific human behaviors. At the end of a phenomenological study, the reader understands the view from the person in that experience. While a phenomenological study would have had merit if the study focus were on the impact of the transformation on the individuals, the focus on my research was on the coordination methods and not the individuals. Therefore, the phenomenological study methodology was not chosen.

Ethnographies identify with anthropological studies. These studies often involve culture as the focus in need to study the beliefs, values, and attitudes of those people within a specific group (Merriam & Tisdell, 2016). Ethnographic studies require significant amounts of time within the group studied and for direct participation by the researcher (Merriam & Tisdell, 2016). An ethnographic study of a chaotic and dynamic transformation process would be an ambitious undertaking. I did not use the ethnographic approach because it required more focus on the concept of the organizational culture, and the culture was not the focus of study. Another reason for not undertaking an ethnographic study was the significant amount of time and full immersion required.

Grounded theory is more specific for revealing potential theories from within the data that is gathered (Merriam & Tisdell, 2016). Grounded theories are useful when addressing questions about a particular process or how something changed over time. Patterns identified during analysis and relationships help build a grounded theory. The grounded theory method addresses processes that may change over time and looks for patterns that may help develop a theory. My study focused on a contemporary phenomenon that is poorly understood. My research focused on trying to improve the understanding of coordination methods used and how the new understanding might improve or reduce the current failure rate of development projects. The grounded theory method is premature, with the gap given the current state of knowledge about scaled agile framework transformation.

Narrative inquiries are a means by which to share lived experiences within the context of current situations. The narrative can focus on specific thoughts, motivations, processes, and human intentions (Merriam & Tisdell, 2016). The narrative can subsequently identify events in chronological order of occurrence; and, discuss actions and what those actions develop into during the study. Although not chosen, the narrative inquiry has some potential to intersect with other methodologies, but there were restrictions on focus on events and processes with which the participants were interacting. Narrative inquiry was not chosen as my methodology because it was not suited for the goal of this study.

Case studies represent the opportunity to consume the complexity of a specific case with high interest and value. Case studies occur within the context of the study

environment and can reveal interrelationships critical to the activities within that environment (Stake, 1995). Gordon et al. (2013) explored the agenda for future case studies and supported Stake's concept of the context of the environment. Case-based research is a primary method to examine human resources. Case studies are an effective, bounded system that needs investigating (Stake, 1995). When a specific question requires greater understanding, a case study may provide insight in response to the research question. A case is unique and increasing knowledge of the phenomena of the matter is a primary objective.

Hancock and Algozzine (2011) agreed with Stake (1995) that the primary goal of a qualitative study is to understand the context and environment under review. Case studies focus on a specific bounded group studied in the group's natural environment (Hancock & Algozzine, 2011; Stake, 1995; Yin, 2014). Yin (2014) described the case study as a logical method when the research questions are why or how, when there is limited control over participant behavior, and a contemporary event is the focus of the study. The case study was an in-depth description of a bounded system and is an empirical inquiry investigating a contemporary phenomenon in a natural environment (Merriam & Tisdell, 2016). The case study's alignment, scope, and boundaries render the case study the best selection for my research.

Role of the Researcher

In qualitative research, the researcher often becomes the research instrument of the study because the measurement of real-world phenomena by another means is not feasible (Yin, 2016). Yin (2014) identified participant-observation as the most common

data collection method used in qualitative studies. Although the observer may be the research instrument in the study, Yin (2014) cautioned that observer as a research instrument does not create the data collection method. The situation varies from the observer, participant, participant-observer, but mostly observer, and participant-observer who engaged as a participant.

Data collection methods in my study included interviewing, observing, and examining organization documents. Interviewing participants allowed me to collect information about their coordination methods. The choice of observer method reflected on my personal and professional experience and the research focus (Yin, 2016). The choice of observer method required my acknowledgment of experience in software analysis and program development, and certified positions as a six sigma Black belt, project manager, and systems production lead. In direct support of my study, I was trained as an advanced scrum master and a release train engineer. My understanding and full disclosure of any preconceived perspectives or biases that might affect data collection in the natural environment and context reduced bias during data collection.

The observer role supported interviews and reflected my ability to balance potential researcher bias, observations, and face-to-face interviews. Observation afforded the capability to prevent bias when interpreting data where views occurred in a more open, casual participant-to-researcher context, and I understood that data within the context of the actual setting where obtained (Takyi, 2015). Researcher experiences may affect the interpretation of the participants and their information. Yin (2016) suggested using a “thick description” to reveal or avoid selection bias when collecting data (p. 41). I

considered expectations before each interview and analyzed post-interview notes to control potential biases from entering the data collections.

Yin (2016) expressed the value of fieldwork to augment interviews. Yin listed the observer's responsibilities to include listening intently to the operations ongoing in the field location, making a good image of actual field activities and documenting carefully, limit assumptions and comparisons with personal experience, and be aware that patterns emerge. As an observer in my study, I became a research instrument and observed and recording events in the field. The coordination activities received close focus. Personal experience or other biases were not permitted to make their way into the field notes. I was the primary research instrument during the fieldwork and ensured the operations in the field were driving the meaning of the observations.

Listing expected responses before the interview, recording the participant's responses immediately following interviews, and reviewing recorded responses enhance the validity of any findings (Yin, 2016). Some potential participants may have been members of projects on which I previously provided peripheral support. During the participant recruitment, pre-interview briefing, and post-interview sessions, I acknowledged any previous associations, and participants understood that my research role was not related to any previous professional relationship. The pre-interview briefing included the purpose of the study following the Belmont Report's guidance (1979). The organization of the research subscribed to the same Belmont Report guidance and employed an IRB internal to the organization, provided to the Walden University IRB before I started any interviews.

There was no supervisory or instructional relationship with any potential participant. The next section identifies the methodology used in the study.

Methodology

The purpose of this qualitative exploratory single case study was to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework. The validity of conclusions from the case study is related to how the case conclusions can be generalized to similar cases (Maxwell, 2012). Case studies often create opportunities to explore new questions (Hancock & Algozzine, 2011). The conceptual framework for my research combined von Bertalanffy's general system theory (1969) and Malone's (1988) coordination theory. The case occurred at the intersection of these two theories, as shown in Table 1.

Table 1

Comparison of General System Theory and Coordination Theory

General system theory (von Bertalanffy, 1969)	Coordination theory (Malone, 1988)
Man-in-the-Loop	The number of people with direct access to computers has drastically increased. Computers and people are connected to each other. Larger number of people using computers to communicate and coordinate their work.
Evolution	Improvements in cost and capabilities of information technologies changing by orders of magnitude. Change of pace accelerating and there is a need for a more flexible and adaptive organization. New ways of organizing human activities.
Information and Adaptation	Lessons learned about how large groups of people coordinate the work can be applied to coordinating large group of computer processors.
Organization	Growing recognition of the commonality of theoretical problems in different disciplines that deal with the coordination of separate actors. Concepts about information processing are useful in analyzing human coordination.

Partner Organization (Case) Selection

Selecting the partner organization was based on several conditions. The company had to be introducing a transformation from traditional waterfall development to a scaled agile framework development method. Employees in the study at the partner organization would have to be working on a scaled agile framework in current projects. Additionally, the transformation to a scaled agile framework would have to be a new challenge in the

organization and would have to have employees that had completed a minimum of one project using the traditional waterfall method.

The case was selected to meet the goals of the study (Maxwell, 2012). My experience working in the aerospace industry for the past 45 years created a proclivity to select an aerospace organization that was at the intersection of the conceptual framework and transforming to the scaled agile framework in a large-scale segment of the organization. I chose a company that introduced a transformation from the traditional waterfall development method to a scaled agile framework development method.

Before the study, I received a letter of cooperation from the corporate partner. The corporate sponsors will receive an out briefing to review findings and to discuss any questions.

Participant Selection Logic

Qualitative studies often use purposive sampling as the primary sampling method (Merriam & Tisdell, 2016; Singleton & Straits, 2010). This case study included purposive sampling methods because I was interested in a unique phenomenon in a real-world environment. The case is contemporary, and the participants operated within the context of that environment (Yin, 2016). The partner organization's transformation team identified participants. The identification of participants by the partner organization reduced potential bias in the selection of interview participants.

I relied on the partner organization to provide a significant number of potential participants who covered the spectrum of expertise relevant to my research. The partner organization transformation team sent all project team members an invitation to volunteer

for participation in the study interviews. A solicitation sent from the partner organization included a summary of the study goals, interview protocol, and letter of cooperation. Interview participants responded directly to me if wishing to volunteer to interview.

Participants for the study were chosen based on a list of specific criteria as follows. The criteria for selecting participants required identifying those participants who had the best opportunity to provide information that addressed the study (Hancock &Algozzine, 2011).

Participants in a case study should operate in their natural environment directly connected with the case under study (Yin, 2014). In my study, the participants came from a large-scale project team. Potential participants emerged from the interview protocol's demographic questions in Appendix A. The first five demographic questions needed to have a yes response; questions six and seven provided a team function within the project The last three questions added to details that helped determine follow-up questions. The large-scale project in my study had more than 300 people assigned to the project. Functional teams included in the project varied in size and averaged 15 members. The operational teams consisted of software and hardware engineers. Systems engineers, quality engineers, team leads, manufacturing engineers, and managers from several levels made up the project team population. Volunteer participants were selected from the partner organization's solicitation of all members of the people within the newly established scaled agile framework project team.

Participants were working on a scaled agile framework in their current project, and scaled agile framework was a new challenge in their organization. Participants had

completed a minimum of one waterfall project before their current project and had the appropriate hardware, software, systems engineering, or management experience for application to their current project. The study design avoided the recruitment of any members from any protected group.

Participants received a letter of the study's purpose and goals, and letters of consent. A list of sample questions was provided before the interview for participants to review. Participants did not operate any equipment and did not need any training for the interview. Each participant had the option to receive a copy of the completed study.

Participant names never appear in the final study. Analytical methods used to analyze the data included transcribing the interviews into a Microsoft Word document and using Nuance Naturally Speaking. Observer field notes and organizational surveys were reviewed and analyzed in conjunction with the interview transcript analyses findings.

Sample Size and Saturation

There is no predefined formula for the number of samples required in a qualitative study. Several sources maintain that an adequate number of samples should be selected to answer the question that the study is attempting to investigate (Merriam & Tisdell, 2016). The researcher needs to understand the definition of an adequate sampling size. In general, researchers use smaller sample sizes to explore details of a phenomenon. The study question should determine the sample size and selection criteria (Maxwell, 2012; Merriam & Tisdell, 2016).

Researchers agree that successful qualitative studies achieve data saturation. Merriam and Tisdell (2016) advocated using a sample size sufficient to reach saturation, when there is no new information obtained through sampling. Researchers have disputed the point at which data saturation occurs (Fusch & Ness, 2015). Fusch and Ness (2015) recommended that interview research designs use semi-structured interviews to reach data saturation. Merriam and Tisdell (2016) agreed with Lincoln and Guba (1985) to sample until no new information appears, and no further information is obtainable to support the study. I decided that the study participant pool was a minimum of 12 and with the incremental addition of two interviews until data saturation

Instrumentation

This study used multiple sources to ensure sufficient data to identify patterns and themes and to answer the research question. The primary instrument in this study was a semi-structured interview protocol (see Appendix A). Other data sources included casual field observations (see Appendix B), and the partner organization's historical documents.

I recorded additional data using an observation journal during visits to an operational area, interviews, audiotape, and archived data. The multiple sources of data in the context of the case study contributed to the validity to the findings (Maxwell, 2012; Merriam & Tisdell, 2016; Yin, 2014; Yin, 2016).

Interviews. Based on the research question, I developed an interview protocol (see Appendix A). A semi-structured interview with the participants allowed new ideas to evolve during the interview. The guide provided a high-level framework for interaction with participants and allowed me to become the instrument within that study (Yin, 2016).

Face-to-face interview questions were the most important and most informative data and asked if coordination practices were the same across different teams. Yin (2016) emphasized using a protocol, or interview guide, which is a mental framework from which to interview. I prepared interview questions related to the research question as a means of staying focused on the study's goals and preventing me from missing an opportunity to gain information on a specific area relative to the study. The interview guide used a set of keywords that allowed me to stay on topic and follow information opportunities to a deeper understanding.

Questions related to cross-team practice questions in the interview protocol helped determine how coordination occurs between the team members with different objectives. Other interview questions uncovered new kinds of coordination structures and demonstrated whether different coordination methods employ in different situations. Some interview questions explored what practical communication coordination tools the interviewee used. The answers to these interview questions provided insight into potential success factors in coordination that may reduce failure rates.

Merriam and Tisdell (2016) suggested that qualitative researchers obtain feedback from participants to correct the interviewer’s incorrect interpretations. Any feedback or corrections to the original interpretation would suggest new opportunities for data that may better support the study questions. Feedback provides an ethical feedback relationship with the participants (Maxwell, 2012; Miles, Huberman, & Saldana, 2014; Merriam & Tisdell, 2016; Yin, 2016). Transcribed interview summaries given to

participants, encouraged them to provide feedback on any transcription items that did not reflect the interview response correctly.

Casual observations. Yin (2016) expressed the value of fieldwork to augment interviews. Observational data collection is relevant to capturing the contextual experiences of social groups and events that are interrelated with the semistructured interviews. The subtle nature of the casual observations have the potential to transfer knowledge not otherwise captured. Participant responses are obtained in an unfiltered context and used as comparative benchmarks. The case study captures phenomena in a real-world context, and the casual observations allow the researcher to capture data in a real-world operational context.

As a casual observer in this study, I became a research instrument and observed and recorded the project team's use of coordination events in an operational area. The coordination activities received close focus, and it became critical that I not allow personal experience or other biases to make their way into the field notes. I was the primary research instrument during the fieldwork and ensured the operations in the field were driving the meaning of the observations. My observer responsibilities included listening intently to the operations ongoing in the field location, documenting an accurate image of actual field activities, limiting assumptions, and comparisons with personal experience, and cognizance that patterns emerge.

As the observer, I created field notes that provided a thick and rich interpretation of observations at the field site (Merriam & Tisdell, 2016; Maxwell, 2012; Yin, 2016). Observation as a data-gathering method can be subjective and required me to be

cognizant of personal biases when interpreting field activity (Merriam & Tisdell, 2016). My extensive background and experience in many of the observer activities had the potential to result in researcher bias and required continuous examination to maintain accurate observations.

Historical organization documents. Yin (2016) pointed out that information previously collected can be a data resource available for capture in the case study. The partner organization had introduced the transformation to a scaled agile framework 2 years earlier, and the organization ran some questionnaires and surveys within the first year of transformation. I gathered those documents and analyzed them to establish a comparison of any changing attitudes in the first 3 years. I was not involved in the first two years of transformation, and my analyses used current observations and context. There were some data in these documents that I had not considered candid, and some of the verbiage in the written answers indicated a desire to be agreeable. Some opposite responses were critical and more transparent. An analysis showed many of the first-year issues remained unchanged when compared to interviews and observations. Some problems changed to a minor degree, but the actual underlying causes of the problems were not apparent, and my study focus was to find those underlying causes. The partner organization's historical documents gave a more comprehensive picture when integrated with the analysis of observations and interviews (see Appendix C).

Procedures for Recruitment, Participation, and Data Collection

Participants had an opportunity to review the interview questions before the interview. Available meeting dates and times for the organization conference rooms sent

to all participants allowed each participant to sign up for a convenient interview time. The interview sessions were first come, first served, and conflicts were resolved by letting all participants know the time slot availability. An alternative session could be selected, or the participant offered an alternative time and place. A reminder was sent approximately 24 hours before the interview and confirmed the participant's availability and continuing interest in the interview.

A semi-structured interview protocol provided consistent procedures for each interview. The interviews were no more than 60 minutes long, using the interview guide. Before interviews, any preconceived thought about participant's responses was recorded in a reflexive journal and reviewed after the transcription of the interview. At the beginning of each interview, each participant received the purpose of the interview and confirmed that their participation was voluntary. Participants affirmed their understanding of the interview and if there were any questions about the study's purpose or the interview process. Just before beginning the interview, the participants had the opportunity to withdraw from the study. A participant consent form and demographic information initiated the beginning of the interview questions.

Interviews were face-to-face and recorded with two audio recorders, one for the interviewer and one for the participant. My recorder automatically transcribed through Nuance Naturally Speaking software. The participant recording device had word spacing capability to allow me to listen to the participant and transcribe the exact response. A second recorder allowed for a backup if one of the recorders had failed during the

interview. The interviews took place at the participant's site, or a site the participant requested (near the participant's location).

I asked questions in sequence from the guide and recorded interview notes in a separate folder for each interview. Observations were documented during the interviews to capture participant body language, postures, voice tones, and specific or repeated word choices during interviews. After each interview, I debriefed the participant and thanked them for the opportunity to draw on their knowledge. Participants received summaries of the interview transcript after the interview and had the chance to provide feedback and any corrections.

The interviews were the primary data gathering instrument and the opportunity to obtain field notes and to review the historical organization data provided alternative sources that added to the validation and credibility of the study. The letter of cooperation from the partner organization authorized the collection of field notes. A field notebook captured observations from the operational development areas, where I acted as an observer. The transformation team escorted me into the functional areas to avoid any discomfort or suspicion of operational units. Observations of coordination methods used in the operational areas were documented in a field log (see Appendix B) and captured words and phrases repeated during the field visit. The full and open access to the partner organization resources provided significant value and was critical to the study's success. The access granted by the letter of cooperation to the organization's historical documents let me see patterns or trends over an extended period and compare those responses with the field notes and interview responses.

Data Analysis Plan

Yin (2014) described a case study as significantly challenging and requiring a robust design and fair analysis. A case study must be flexible yet needs to maintain more formal procedures to maintain credibility as a qualitative method (Yin, 2014). Data analysis required me to be flexible and continuously alert to changes in the environment. The cross-boundary data collection through vehicles such as interviews, observations, and historical organization data required a constant analysis before, during, and after each interaction within the study environment. The study required commitment to understanding the complex interactions that occurred within the social phenomenon and to continually evaluate and analyze data in a holistic frame of reference.

There is a consistent agreement among qualitative authors that concurrent analyzing and interviewing is a good practice (see Miles, Huberman, & Saldana, 2014; Yin, 2014; Yin, 2016). Yin (2016) suggested continuously reviewing transcribed interviews. The more familiar I was with the transcribed words, the better the opportunity to see patterns and relationships emerging. Early emerging patterns offered me a chance to vary interviews or look for specific links that were not identified earlier in the study.

I used diagrams and concept maps to add to a holistic data analysis process. A comparison of pre-interview and post-interview comments prevented the participant from being analyzed from a biased perspective, and observations of participant interviews captured body language, postures, voice tones, and specific or repeated word choices. Analysis of interviews occurred within 48 hours of interviews. Reviews of documented notes and transcribed interviews within the constraints of the cumulative interviews

happened at that point in the process. The words and patterns in the transcripts underwent transcription initially and again with each subsequent transcript. If any words were unrecognizable on the recording, the section was tagged appropriately and compared to the bracketed files in the reflexive journal. Providing the transcript to the participant for review offered the opportunity to recover any incoherent verbiage. Each review had a version number to identify when reviewed, and each version had notes defined within the text to annotate researcher analytic notes, keywords and phrases, and patterns identified. Subsequent transcripts received comparison to previous words, phrases, and patterns. Analyses followed the suggestion to concurrently analyze each interview is transcribed and to review all the interviews until all interviews end. The process followed offered some insight into keywords and phrases, and possibly identified important patterns earlier in the study.

I used computer-assisted data analysis software to support the data analysis process and to provide some added credibility and reliability to the findings. I used Atlas.ti8 because it was best suited for the case study, and coding efforts began during the initial interview and concurrent analyses.

According to Miles, Huberman, and Saldana (2014), codes are “prompts or triggers” that alert the researcher to areas that should get additional analysis (p. 73).The initial level of coding helped to identify words and phrases that were related to each of the interview questions. As each level of analysis progressed, and patterns emerged, additional levels of coding appeared. My continued analyses of all sources of data and the consecutive analyses of interviews revealed emerging patterns and themes.

The data analysis plan followed the same process with observer notes and other data collected during field observations. Interviews, field observation notes, interview notes, and historical organization data received continuous analysis in a holistic manner (Maxwell, 2012; Miles, Huberman, & Saldana, 2014; Yin, 2014; Yin, 2016). My case study took a holistic approach to the organizational transformation from the perspective of coordination methods, and continued review and inclusion of data collected allowed me to evaluate personal thinking with what participants said continually.

Issues of Trustworthiness

Trustworthiness concerns how the results match reality (Merriam & Tisdell, 2016). Case studies have challenges to trustworthiness based on the selection of the case, time constraints, and the unique environment in the study (Denzin, 2009). Trustworthiness began with my attitude and commitment to procedures that allow others to understand the findings and conclusions. I embedded trustworthiness in the methods employed during the research and data collection (Yin, 2016).

Yin (2016) stated the researcher needs research procedures and to be concerned with demonstrating that the research is authentic. Actions that support this study's trustworthiness include triangulation, adding time to the study to increase understanding of the context, reviewing similar research, including variations in perspectives to the research, and seeking and identifying evidence that may be in opposition to expected findings (Yin, 2016). Building trustworthiness required me to address the issues of credibility (internal validity), transferability (external validity), and confirmability

(objectivity) (Merriam & Tisdell, 2016; Miles, Huberman & Saldana, 2014; Maxwell, 2012; Stake, 1995).

Credibility

I considered credibility while designing the case study. An essential goal of the design in this case study was to ensure that data is collected and analyzed in a fair method (Yin, 2014; Yin, 2016). Researchers must recognize the ethical obligation to avoid misrepresentations and prevent any misunderstandings in the case study (Stake, 1995). To establish credibility, I was required to understand the context within which the participants are interacting. Understanding the processes that occur within the case study context and the effects on participants reduced credibility to conclusions reached by the study (Maxwell, 2012). Maxwell (2012) cautioned that bias and reactivity negatively impact credibility. Measurements needed to be assessed by a multiple set of criteria.

My case study used multiple sources of data that included observer field notes, interviews, and historical organization data. Each of these sources of data can introduce erroneous data and weaken the credibility of the study. Participants may feel threatened and not be entirely truthful in their disclosures. Participants may distort data, omit data, or deliberately introduce false data (Maxwell, 2012). Especially during interviews, being a good listener, inquisitive, and avoid allowing questionable data to enter the data collection was necessary. I verified the evidence gathered and rechecked when possible (Yin, 2016). Denzin (2009) made the point that no single method works for all data gathering credibility. Corroboration of the data gathered, and the interpretations of that data required feedback methods and triangulation (Merriam & Tisdell, 2016; Miles,

Huberman & Saldana, 2014; Maxwell, 2012; Stake, 1995). Although qualitative research is subjective, there was a fundamental need to search for patterns, explanation building, and consistencies, as well as rival explanations. (Stake, 1995). Using multiple data sources allowed the study to create a case study database that maintains a chain of evidence, enables comparison of patterns, identifies alternative findings, and creates a strong case through increased credibility (Yin, 2014).

Transferability

Simon and Goes (2013) defined external validity as the generalizability of the study findings to participants in another environmental context. Yin (2014) identified the fact that a single case is a unique context with unique participants and may not readily extrapolate to generalizations. However, analytical generalizations emerge as a new concept that results from the completion of this case study research (Yin, 2014). I had to determine the usefulness of the unique case situation and identify specific degrees of similarity that could afford the transferability of the findings. Transferability requires a slightly more reserved claim than might be the result of analytical generalizations (Yin, 2016). Alternative causal factors not identified or measured could have been influencing the findings (Denzin, 2009). Problems related to external validity include whether observations made by the observer can be generalized and do those observations provide real differences (Denzin, 2009). When considering the potential to transfer to another setting, I considered the unique environment selected for the individual case study (Miles, Huberman & Saldana, 2014). If the findings included thick descriptions, others could

assess transferability to their settings, and the results replicated (Miles, Huberman & Saldana, 2014).

Dependability

Dependability (reliability) considers whether the study operates consistently, and if a researcher that followed the same procedures would arrive at the same conclusions (Miles, Huberman & Saldana, 2014; Yin, 2014). A qualitative study supports consistency, questions are clear, the researcher's role and status in the study are detailed, multiple data sources provided, a consistent protocol established, and quality checks performed to avoid bias (Miles et al., 2014). The case study protocol increased the reliability of the case study by providing me with a framework and a mindset used during each participant interview. The protocol also applied to notetaking during observations. The protocol, along with the case study database, helped organize and document data collected and provided a chain of evidence for the data (Yin, 2014).

The audit trail and chain of evidence supported the study with a clear research question, identified my role in the study, and a conceptual framework connected to theory. Data was collected to match the research question and study objectives. Continuous quality checking improved data quality. Field notes and journal documentation recorded the process of gathering and analyzing data, and all documents reside in the case study database.

Continuous and concurrent analysis of all data sources compared observations with interview data collected. The protocol and chain of evidence allowed external users to follow and determine if the data collected was enough to answer the research questions

(Yin, 2014). All hardware and software used in the study were maintained, and virus protection was updated to ensure the integrity of the data collection and analyses. Data were collected in all formats to include paper, recordings, digital files, hand-scribed notes, field journal notes, ad hoc drawings, and computer files. All data were locked in a fireproof safe in all formats, and all storage devices were password protected. As directed by law, data destruction occurs after the recommended five years.

Confirmability

The concern is my neutrality and ability to reduce biases that may have affected the research findings (Miles et al., 2014). Maxwell (2012) was concerned with the researcher's identity that reflected the assumptions and experience or knowledge that might influence researcher interpretations. Yin (2016) suggested that an external observer could trace the steps from the conclusion back to research questions or research questions to conclusions. General methods and procedures allow another researcher to use the same framework and repeat the findings of this study (Miles et al.). Objectivity was demonstrated by clearly documenting assumptions and biases that may influence me and expressed when I acknowledged alternative conclusions (Miles et al.; Yin, 2014). Data audits are available through the storage of specific methods and procedures, a clearly defined sequence of steps for collecting, processing, analyzing, and displaying data, and linking findings with the data collected. The study identified all biases and how bias could potentially impact study findings. A goal of this study was to discover alternate explanations and results and document these alternatives for future studies. An orderly

collection of the study data was retained and can be made available for reanalysis by other researchers following the institutional review board guidelines (Miles et al.).

Ethical Procedures

Qualitative research has been called human science research. Code of Federal Regulations (CFR) Title 45 Part 46 governs the actions of researchers who conduct human science research. These regulations provide participant protections, irrespective of the participant's location. Legislators enacted these regulations because of the Belmont Report findings (1979). The Belmont Report (1979) established three ethical principles for the conduct of human science research: (a) respect for persons (b) beneficence, and (c) justice. The Belmont Report listed three conditions that researchers must meet for the conduct of a human science study: (a) informed consent (b) assessment of risks and benefits, and (c) selection of subjects. Walden University requires researchers to be trained to conduct human science research projects. I completed the Collaborative Institutional Training Initiative Human Subjects Protection Training Modules as part of the preparation for corporate Institutional Review Board (IRB) to approve my study.

Corporate IRB approval and Walden University IRB approval was obtained before collecting any data. The corporate IRB and the Walden IRB protects participants' well-being by overseeing student research. These actions meet recommendations for conducting human science research. An informed consent document was developed, which provides background information about the study.

Participants were sent the consent letter and brought the consent form to the interview. When the participant arrived at the interview, the consent form was signed and

collected before the interview began. The consent letter explains participation is voluntary. The consent letter listed any risks and benefits of participating in the study and indicated measures to assure participant privacy. Interviewee names became a pseudonym composed of a letter and number to maintain confidentiality. Names eliminated from any point in the study. Finally, the document contains contact information for the IRB, chair, and researcher. The interview guide maintains a consistent process for informing participants of their rights and the conduct of the interview.

Participant interviews, researcher field notes, and other materials may provide identifiable information and safeguarding confidentiality. Electronic data held in password-protected media. Paper data, digital recorders, and flash drives were locked in a fire-resistant safe, and data destroyed in accordance with 45 CFR 46. Protection and confidentiality of the documents during destruction are necessary, and paper records are shredded and recycled. Files stored on a computer hard drive get erased using commercial software applications designed to remove all data from the storage device. Data stored on USB drives or recorded data on tapes, CDs, or DVDs, will be physically destroyed. A record of the destruction maintained that contains the name of records destroyed, when, and how destruction occurred.

Summary

Researchers can conduct case study research in several ways. I used Yin's (2014) case study method to explore the coordination activities of employees who are members of an organization, transforming it from a traditional waterfall method to a scaled agile framework methodology. Chapter 3 began with a description of the research design and

rationale, which presented the reasoning for the study method, the researcher's role, and the study research questions. The remainder of the chapter covered the research methodology, data collection, and analysis procedures. Methods used to handle issues of trustworthiness include credibility, transferability, dependability, and confirmability. Finally, ethical procedures were listed. This section listed agreements to gain access to participants or data. The corporate IRB required CITI certification before IRB submission and that corporate IRB approval was submitted to the Walden IRB.

Research participant recruitment selected from an organization that was in transformation from traditional waterfall development methodology to a scaled agile framework methodology. Chosen participants had at least one full traditional waterfall development experience and are currently on a scaled agile framework development project. Participants who held a specific scaled agile framework role and management representation included in those recruited. The design supported the purpose of the study. Chapter 4 further describes the processes used for data collection and analysis and provides the research findings.

Chapter 4: Results

The purpose of this qualitative exploratory single case study was to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework. Solving a new business problem relies on experience, and there is a gap in knowledge of the coordination required to support how projects achieve successful transformation. Interviews with 12 participants in a large-scale organization transforming to scaled agile framework yielded the needed data. The research question and subquestions were as follows:

Research Question: How does a large organization transforming to scaled agile framework use coordination methods to support software and systems engineers to potentially improve the success of the implementation of the scaled agile framework?

Subquestion 1: How is coordination achieved in a scaled agile framework environment?

Subquestion 2: How does coordination increase the successful transformation to scaled agile framework?

Subquestion 3: How does the coordination process impact interaction between members of the project to reduce failures?

The research question reflected gaps in the existing literature on the experiences of engineering teams in the process of transforming from a waterfall process of development to a scaled agile framework. The subquestions focused on specific areas of coordination where research gaps exist in how coordination could be efficient and reduce transformation failures. Dikert et al. (2016) found that large-scale projects needed

additional coordination and a systemic overview. Strode et al. (2012) found coordination was taking place within the agile approach; however, the form and nature of coordination were not well understood. Strode et al. identified coordination as critical for the success of agile processes. Amici and Bietti (2015), Dikert et al., and Strode et al. found a gap in understanding how to achieve effective coordination. That gap in understanding how coordination supports the change to the scaled agile framework has psychological, social, and financial impacts on business and the organization's potential existence.

My study aimed at understanding the gap in knowledge of during a transformation to the scaled agile framework. A better understanding of this process will facilitate using workers' job experiences in transforming workplaces and contribute to a successful transformation of organizations. This chapter describes the results of the exploratory single case study. I performed a thematic analysis of data from multiple sources:

1. Recorded and transcribed semistructured interviews
2. Casual observational field notes I kept throughout the data collection process (see Appendix B)
3. Historical organization data (see Appendix C)

The second step was a case analysis with which the findings of the initial thematic investigations of interview data were synthesized.

In this chapter, the recurring themes and coding categories are presented in detail and supported by participant voices. This chapter includes tables of summarized demographics of the study's participants; coding, categories, and themes; and a case synthesis of themes across cases.

Research Setting

Data gathering occurred through a review of historical organizational documents that included archived corporate questionnaires, archived corporate surveys, field observations, and face-to-face interviews. Interviews occurred in corporate conference rooms of the participant's choosing, and all participants were in proximity to three building complexes. Travel to these locations was not an issue. The in-person face-to-face interviews were conducted in two buildings because participants requested to hold the interviews in these two buildings (see Table 2). There was no significant organizational change during the interview period, such as, personnel changes, budget cuts, or other actions that negatively influenced the participants, which could have influenced the research results. All participants chose a corporate conference room for their interview. Conference rooms varied based on availability, and a convenient time for the participant; however, all conference rooms arranged were close to the participant and were limited to six locations (see Table 2).

Table 2

Participant Interview Locations

Participant alias	Interview location	Interview date
P1	H288.114	7/27/2019
P2	H288.112	9/25/2019
P3	H288.133	8/2/2019
P4	H288.112	8/23/2019
P5	H288.112	8/28/2019
P6	H288.260	9/9/2019
P7	H288.101	9/18/2019
P8	B302.202	10/10/2019
P9	B288.114	9/25/2019
P10	H288.260	9/27/2019
P11	H288.101	10/11/2019
P12	H288.133	10/18/2019

Demographics

The demographic information collected from interview participants identified their experience with the transformation, experience with organization restructure, improved quality management, and coordination methods implemented to enhance collaboration and reduce the probability of the transformation failure.

The target sample size for this study was no fewer than 12 participant interviews, or until saturation was achieved. Data saturation was reached at the twelfth interview and was enhanced by a discrepant perspective with the tenth interview.

Table 3

Participant Demographics

Participant alias	First time transforming to scaled agile framework Y/N	Role in helping achieve the project	Management Y/N
P1	Y	Software	N
P2	Y	Software, IT	N
P3	N	Software, Design	Y
P4	N	Hardware	N
P5	Y	Software	N
P6	Y	Software	N
P7	Y	Software, Quality	N
P8	Y	Implementation	N
P9	N	Systems Engineering	N
P10	Y	Software	Y
P11	N	Software	N
P12	Y	Integration	N

Twelve participant interviews provided saturation for the study. The volunteer participants covered the age groups from recent college graduates to senior engineers. All interview participants were employed by a global aerospace company and on a large-scale program that was transforming to the scaled agile framework. All participants had completed at least one waterfall development project, and all participants were on a program of over 500 people and working on one of 25 different teams. Table 3 depicts additional information about the participants.

Data Collection

The partner organization in this study was early in the transformation to a scaled agile framework. Two historical organization documents completed 2 years earlier than my study, and less than 6 months after beginning the transformation, included a survey and a questionnaire took the pulse of the organization's reaction. These surveys provided

a limited perspective into the early transformation (see Appendix D). I collected the historical organization documents as a valuable resource and material that would triangulate data gathered from the participant interviews. The participant interviews were the primary source of data, and the historical organization surveys captured a perspective on the evolving environment. A semistructured interview protocol provided the primary method of information collection (see Appendix A: Interview Guide). Each participant received a unique letter-number identifier. The partner organization approved field observations, and a field observation protocol provided consistent evaluations (see Appendix B: Observation Protocol).

Interview participants are referred to by a letter and number, using the forms P1, P2, and continuing through P12. The participants chose the date and time for scheduled one-hour interviews. The interviews took between 50 and 70 minutes. The interview participants were open-minded and enthusiastic about responding to the interview questions. Two recording units were used during the interviews, as planned. The participants were free to return comments on the email transcript summary or call the researcher directly.

I collected demographic information before the interview to ensure participants met value-added requirements for the interview. In the face-to-face interviews, I recorded notes on the interview protocol question sheets to describe the nonverbal indicators and other potential nuances of participants. For all the interviews, the field notes identified topics to follow up on during the interview or points to clarify.

Before beginning the interviews, I identified several expectations to myself that might introduce bias in my interpretation of the responses. After each interview, I reviewed the recordings and transcribed the data. Using the same set of questions provided a consistent framework for assessing my preconceptions and my reactions. While considering the recordings and transcriptions following the interviews, I identified items that needed to be clarified or reworded in subsequent interviews, to facilitate participant understanding of the questions.

Data collection began after receiving permission from the Walden University (IRB approval # 07-12-19-0084742) on July 12, 2019. Data collection for interviews lasted 12 weeks. Observations required an additional month. All 500 members of the program used in this study received an email. Volunteer participants responded more slowly than expected due to the heavy workload. The ongoing transformation in the organization was a disruptive event. Responses to my request for participants occurred over many weeks. Once volunteer participants contacted me for an interview, they requested the interview occur as soon as possible, and I accommodated each request.

After each interview, I downloaded the audio file from the digital recorder into Sony optimization software to convert it into an mp3 file. I used Nuance Dragon Naturally Speaking to transcribe the recorder file into an MS Word document. While listening to the mp3 recorder file, I edited the transcribed text. I included parenthetical comments to describe the participant's presentation and comfort levels. I added other comments and editing to indicate the sighs, pauses, and other non-verbal inputs from the participants. I reviewed the Dragon Naturally Speaking transcriptions in Atlas.ti8

qualitative data analysis software. I added emotive sounds such as laughs, chuckles, sighs, and hmmm further to present the participant's posture during the interview.

Only one instance occurred where data collection did not go according to plan. The first interview was using an older recorder, and it would not convert the recording. This device would not work with the new software after several investigations into the device and software updates. A scan disk chip was removed from the recorder, plugged into the computer, and worked flawlessly. I replaced that recorder with a new recorder for all subsequent interviews

Reflective Casual Field Observations

I documented casual field notes to capture my observations of the actions of the participants on the transformation teams. The observation protocol was a matrix that allowed me to produce a score for observed coordination practices (see Appendix B). Since this was a casual observation, I did not have any verbal interaction with those in operational situations. Interpreting the observations into a number proved to be more challenging than expected. It was necessary to enter handwritten comments on the individual observation protocol sheets used for each operational situation. I was disappointed in the data gained through casual observations, and the added handwritten notes provided the ability to meet the observation objective to compare responses against actual operations and to expand the observations beyond a fixed number. The handwritten notes, in addition to the rating numbers on the observation protocol provided more vibrant descriptions of how the discrete numeric ratings applied to each observation. Casual observations during operational situations had limited value, but

follow-up comparisons with interview responses did provide support for establishing patterns and themes. The participant's mindset may have been expressed nonverbally during observations and provided valuable information when combined with what an interviewee said during their interview. The mindset was often more apparent concerning responses to managerial experiences. Overall, participants expressed ample awareness of the challenges they experienced in the work environment and had strong opinions on issues that included resources, work climate, and leadership incongruities. Although the study focused on the coordination methods that could reduce transformation failures, discrepant cases relating to age and leadership provided unexpected relationships that have a significant impact on coordination methods within the transformation.

Data Analysis

I used a thematic analysis coding strategy to analyze the raw data collected and look for emerging patterns in response to interview questions (Braun & Clarke, 2013). I used the emerging words and phrases to develop patterns, to categorize, and to evolve into identifiable themes. The collected data from interviews created a depth of detailed information from the participants' context in a real-world situation. The interviews represented the in-depth knowledge of the 12 participants and insight into the methods used and relationships impacted by coordination during a transformation to the scaled agile framework. This part of the analysis was an iterative process and repeated the process until the data reduced to a focused group of core factors (Braun & Clarke).

Computer-assisted data analysis software (Atlas.ti8) supported the analysis process to provide some added credibility and reliability to the findings. Coding efforts

began with hand-written notes on the interview sheet during the initial interview and concurrent analyses. The coding continued by writing on the transcribed document to mark key or repetitive words and phrases. I annotated any unexpected or discrepant data on the report before the next phase. The data analysis plan followed a similar process with observer notes and other data collected during field observations. The inclusion of all interviews, field observation notes, interview notes, and organizational, historical data underwent analyses in a holistic manner (Maxwell, 2012; Miles et al., 2014; Yin, 2014; Yin, 2016). I identified and tagged significant discrepancies to add further analysis to determine the cause of the variations.

I used the Atlas.ti8 word cloud function to identify words that frequently appeared in the data. Next, I used the analysis tables in Atlas.ti8 to set up several matrices that recognized keywords used across the participants. Using a table to list all the critical codes identified indicated a better grouping and simplification of codes was required.

The interview transcripts were analyzed in part through the transcription process while reading and adding new transcripts into Atlas.ti8. The review involved reading the transcript and not making any notes. The reading provided an initial report of the interview conversation. Subsequent interpretations of the interview transcript include highlighting phrases and material on the transcribed document and gaining an added understanding of the participant responses. I began assigning descriptive codes to the underlined content. The hand-written codes loaded to Atlas.ti8 with the transcripts. Comments were attached to the codes in Atlas.ti8 and provided added insight to the code. After completing each transcript integration into Atlas.ti8, each transcript review used the

analysis matrices available in the tool. I exported interpreted matrices into an MS Excel, and further evaluated the data.

During the subsequent reviews of the transcripts, I looked for previously annotated or discrepant comments. I began to identify emerging patterns that could be analyzed further. Interpretations of the data started to present themselves, and some inconsistencies emerged. Subsequent reviews of the data focused on the language used by the participants. The further analysis helped me to understand the data in relationship to the participant's perspectives. I used the descriptive codes, interpretation of the codes, and my understanding of the participant's comments to develop the group codes (see Appendix D).

Descriptive Codes

Codes identify aspects of the data that relate to the research questions and to enable a cross-comparison of responses (Braun & Clarke, 2013). The codes and their source material were exported into an MS Excel file for analysis. The descriptive codes allowed me to group similar interview material for additional analysis. I developed the descriptive codes and continuously worked from that baseline of descriptive codes. I identified redundant word codes and began to group codes into meaningful category and theme groups, as noted in Table 4 and Table 5.

Table 4

Categories and Sub Research Questions

Sub Research Questions	Category
Subquestion 1	Achieving large-scale coordination
Subquestion 1	Transforming organization culture
Subquestion 1	Awareness and effective collaboration
Subquestion 2	Environmental context
Subquestion 2	Transforming organization structure
Subquestion 2	Uncertainty
Subquestion 2	Humans as part of the system
Subquestion 2	Value and performance
Subquestion 3	Environmental context
Subquestion 3	Psychological safety
Subquestion 3	Personalities and perspectives
Subquestion 3	Competing objectives
Subquestion 3	Humans as part of the system

Atlas.ti8 provided a list of 698 initial codes. Repetitive analyses and category code groupings reduced the codes into ten significant groups (see Table 5). A resultant matrix shows which codes appeared consistently across the organization. Five descriptive codes appeared more than 50 times. All interview participants provided comments on the top five code groups. A review of each interview question assigned to each of the research question groupings resulted in the sub research question categories in Table 4.

Table 5

Group Matrix

	P1	P2	P3	P6	P5	P8	P9	P7	P12	P11	P10	P4	Totals
Cognitive diversity	8	3	26	11	7	11	8	10	10	10	16	13	133
Cross boundary	4	9	12	9	23	17	8	11	8	12	9	8	130
Transformational leadership	7	5	14	5	5	17	2	6	5	3	5	7	81
Knowledge transfer	1	6	4	6	10	8	4	9	2	13	7	4	74
Effective efficient performance	1	2	2	5	8	5	3	4	9	3	4	8	54
Quality	1	1	2	5	4	2	6	6	2	3	4	2	38
Overcoming transformation challenges	0	1	0	4	4	4	1	1	0	5	5	2	27
Blocking artifacts	0	0	2	1	0	3	1	1	2	3	2	0	15
Centralize decentralize	5	1	0	0	0	1	0	1	0	0	0	0	8
Aligning capacity	0	0	0	0	0	0	0	0	0	1	0	0	1
Totals	27	28	62	46	61	68	33	49	38	53	52	44	561

Word Cloud

Atlas.ti8 has a tool that produces word clouds from the text in the transcripts. The tool can create cloud sizes from one word to 628 words. The 12 transcripts provided many words that repeated with each interview question, article, and words that were not relative to the interview question. The Atlas.ti8 tool allowed me to remove these words from the word cloud. The word cloud did not immediately appear to be relevant or aligned with code groups. Continued analysis and reducing the word cloud to those terms above 300 instances revealed some correlation with the code group findings. Table 6 provides the five most used words in the 12 transcripts. The analysis had to consider

these words from a holistic perspective. The pure volume of a word repeated did not directly relate to the significance of that word, but the word may provide some relative importance within the holistic view. Most of the words with high repetition were the result of common phrases and not relevant to any interrelationship with coordination (see Table 6). The holistic perspective was able to filter out irrelevant terms and group similar words that offered a collective view and significant relevance to coordination effectivities.

Table 6

Word Cloud Counts

Word	Count
Coordination	590
Team	538
Know	458
Think	383
People	304

Discrepant Cases

Discrepancies arose when discussing Question 1.b., which was: "Do you have what you consider the most effective communication tools; which ones do you consider are the most effective?" P3 commented that what worked well for their team "was the paper route." P4 felt, "person to person isn't always the most effective anymore." When asked question 2.a., about the proximity of the other team members' effect on coordination, P3 felt some teams did not coordinate with other teams right next to them, and P5 felt that proximity was helpful, but "WebEx and phones" were enough. P10 agreed that it does have a positive effect on coordination, "when it shouldn't." P12 felt

"culture is what dictates, not necessarily the proximity."

In response to question 4.a., "What effect does coordination have on the team schedule," P6 responded, "Sometimes it can become a micromanaging situation, and no one likes micromanagement." P12 responded that "Coordination methods and structures can be terrible, and they can be wonderful. I would say it's deeper than that. It starts with the person." Social capital responses provided the most significant and most enlightening answers. These social capital responses and the leadership and management responses were not expected based on the literature review and knowledge of the scaled agile framework transformation.

The consistent responses on these two issues were critical to the findings of this study. Question 6.b. asked the participants, "what is the social capital value?" All responses identified either younger members of the team or members of the team with similar backgrounds. One response indicated that most of the team members were graduates of the same university. P10 offered an answer that contradicted all other responses and critically realigned the positioning of its direct effect on a successful transformation. The discrepant instances about leadership and age group perspectives unveiled an unexpected overarching theme. Subsequent research on how and where these two concepts fit into the coordination and transformation puzzle resulted in identifying the overarching theme of cognitive diversity.

The discrepant cases provided the final perspective on the coding transition to categories and themes. The lower part of the coding and theme examples table was helpful and indicated a better understanding of the responses present in every interview

and unexpected answers. The comments on different age groups within the study and the transformation leadership did not align with the overall interview questions. The continued effort to understand how these responses revealed themselves during the interviews required investigations into non-technical and non-engineering disciplines. It was during this added research that the concept of cognitive diversity appeared. The knowledge that cognitive diversity added enabled the responses to be understood and identified an overarching theme as shown in Appendix E.

Evidence of Trustworthiness

Credibility

Maxwell (2012) cautioned that bias and reactivity negatively impact credibility. As the researcher, I had the ethical obligation to avoid misrepresentations and prevent any misunderstandings in the case study (Stake, 1995). To establish credibility, I was required to understand the context within which the participants were interacting. My case study used multiple sources of data that include observer field notes, interviews, and organizational, historical data compared to reduce any possibility of researcher bias. Strict observation of participants occurred during interviews and purposely made comfortable to obtain open, honest, and fully descriptive responses to interview questions.

Yin (2016) discussed several ways to conduct triangulation in a qualitative study. Member checks during the interview used the format of clarifying questions. During the interview, these member checks allowed participants to correct any misapprehensions about what they said or about their experiences. The 12 interview participants came from

a single organization and offered the opportunity to triangulate their experiences of the same event. I compared interviews against each other, a form of triangulation recommended by Patton (2014). In conformance with the credibility strategies listed in Chapter 3, face-to-face interviews allowed me to compare observations with interview data, field observations, and historical organization documents. Full, detailed descriptions provided details of participant experiences. In conclusion, the study meets the requirement for internal validity.

Transferability

Simon and Goes (2013) defined external validity as the generalizability of the study findings to participants in another environmental context. Yin (2016) identified the fact that a single case is a unique context with unique participants and may not readily extrapolate to generalizations. However, analytical generalizations happen as a new concept that results from the completion of this case study research (Yin, 2014). Transferability requires a more reserved claim that might be the result of analytical generalizations (Yin, 2016). Alternative causal factors not identified or measured could influence the findings (Denzin, 2009). This research study contains thick, rich descriptions that readers may match to their life experiences and organizational context and will be able to assess transferability to their settings (Miles, Huberman & Saldana, 2014).

The interview participants in the study were all volunteers who provided a lens into what large-scale project experiences during transformation to the scaled agile framework. The interview population consisted of twelve participants. There were five

software engineers, one software and design engineer, one software and IT engineer, one hardware engineer, one software quality engineer, two integration engineers, and one system engineer. Two of the twelve participants interviewed we managers.

Dependability

The process met dependability because the study occurred consistently, and another researcher that follows the same procedures would arrive at the same conclusions (Miles et al., 2014; Yin, 2014). This qualitative study included consistent and precise questions, described the researcher's role and status in the study, multiple data sources, an established and compatible protocol, and quality checks occurred to avoid bias (Miles et al., 2014). The case study protocol increased the reliability of the case study by providing me with a framework and a mindset used during each participant interview. This study had clearly described and consistent research procedures. The procedures covered participant selection, data gathering, data analysis, and data integrity maintenance.

An auditor would find a transparent process for following the study from data collection through data analysis. MS Word documents and hand-scribed notes on documents capture reflections about the material I reviewed. A folder holds all printed or hand-written material associated with a participant. The study has a clear research question to support the audit trail and chain of evidence, and a conceptual framework connected to theory. Data was collected to match the research question and study objectives. Continuous quality checking performed and improved data quality. Field notes and journal documentation recorded the process of gathering and analyzing data.

The data management folder contains information on the code, the code meaning, and when it entered the Atlas.ti8 files. All physical and electronic records are readily available in the case of an audit.

Confirmability

I followed the confirmability strategy proposed in Chapter 3. The data will be held for five years and then destroyed per the plan approved by the IRB. M.B. Maxwell (2012) was concerned with the researcher's identity that reflected the assumptions and experience or knowledge that might influence researcher interpretations. I observed this to be a continuous challenge during the study. Copious amounts of data gained during the literature review suggested the most probable answers to the interview questions. Several reviews of the transcripts were required to capture the intended response from interview participants.

The discrepant comments captured and identified in the data analysis section above support the confirmability of this study. Study conclusions emerge from the data. A goal of this study was to discover alternate explanations and document these alternatives for future studies. An orderly collection of the study data is retained and can be made available for reanalysis by other researchers (Miles et al., 2014).

Study Results

I centered this exploratory, qualitative single case study on understanding how a large organization transforming to a scaled agile framework uses coordination methods to support software and systems engineers to potentially improve the success of the implementation of the scaled agile framework. Three research subquestions were defined

to investigate how coordination in a scaled agile framework environment occurs, how coordination increases the successful transformation to the scaled agile framework, and how the coordination processes impact the interaction between members of the project to reduce failures.

The case study findings and results for each interview question uncovered relationships and afforded a better understanding of the complexity of events during transformation. Data obtained during interviews and subsequent analyses included historical organization documentation and observations (see Appendices C and D), identified behaviors, actions, and interrelationships that pinpointed the patterns and themes identified from the analyses. Study findings emerged from two perspectives: the case study overview of the complex interactions of the transforming system and the thematic analysis of the data.

Case Study Overview Complex Interactions of the Transforming System

Yin (2016) saw data collection as constant, and analysis performed as the data was collected. The analysis was a continuous process throughout the data collection and coding efforts. In the context of the process and cultural transformation studied in this research, the assumption was that participants would comprehend their work environment based on historical and social perspectives. Findings from the study are that the complexity and change initiated by a total transformation of the organization and the introduction of the scaled agile framework rendered that assumption incorrect. Face-to-face interviews provided the opportunity to analyze other assumptions expected during

this study, and I was able to identify causal factors that intervened to modify or eliminate those assumptions.

One assumption that was true in this study was the assumption that the communication between the researcher and the research participants would be open and honest, and another was that research participants would be representative of the project's transformation population. Research participants were knowledgeable about their organizational situation. They were skilled sufficiently to propose solutions supporting transformation, and research participants had different opinions on how to transform design and software products. Systems engineering teams were not well trained in agile processes and did not interpret communications in the same manner as software engineers. Since the causal links in real-life experiences are complex and patterns may not be readily observable through just a thematic analysis, the analysis process incorporated the perspective of general organizational evaluation and multiple project teams or agile release trains.

An in-depth analysis of the interviews indicated some participants had sensitive areas of concern and may not have added to one of the themes while trying to focus on their unique interest item. The diverse backgrounds and engineering disciplines are shown, in the interview transcripts, to have various interpretations of some of the questions from different engineers. Figure 3 represents the relationships among the key themes found in the analysis.

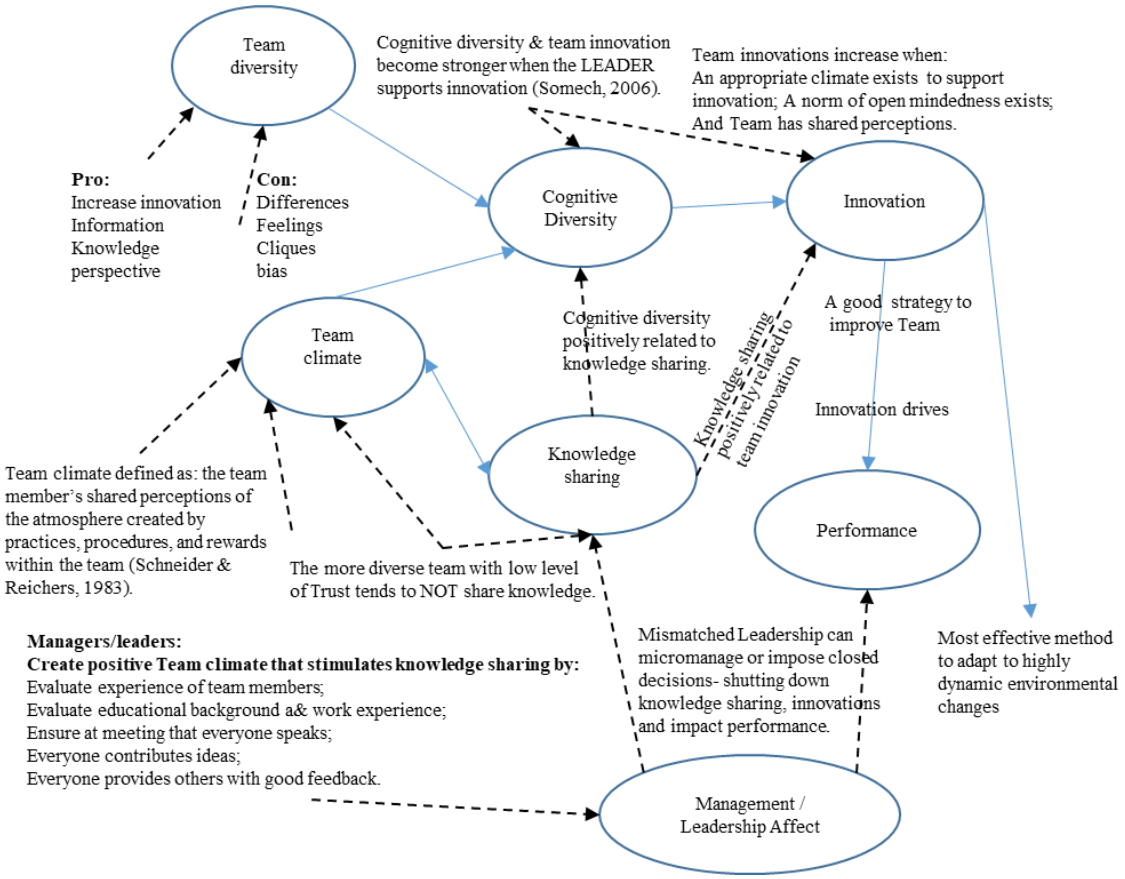

Figure 3. Case study overview relationships among the key themes.

Transformation to large-scale and knowledge transfer. Transformation to the large-scale development and implementation of a scaled agile framework introduces new complexities and new areas of innovation. Reviewing and grouping the themes matches the four significant functional spaces within a system that is in transformation. Tracing interrelationships across themes will provide a detailed description of participant environments and challenges within the organization's restructuring and transformation. All participants were struggling with the transformation at one point or another and were open with their descriptions. Participants provided positive comments about the transformation, as well as professional criticisms that were clearly defined.

On the theme for knowledge transfer, participants all identified with concerns related to knowledge transfer. Some participants felt there were gaps in awareness and knowing what teams could provide the knowledge required by the participant. Open knowledge transfer between teams would demonstrate the ability to build trust and increase knowledge flow. Participants recognized the opportunity to coordinate with someone who has the necessary knowledge would help to keep the schedule and avoid wasting time doing something of no value. All participants discussed knowledge transfer from independent perspectives. Most interpreted the knowledge transfer as getting information to a specific team in synch with the schedules. A few interview participants indicated they use some mapping product to track progress and gain knowledge of how the team was doing against the plan. Some participants discussed knowledge transfer concerning retention and career growth in a technical position instead of management. They saw decades of subject expertise, leaving without transferring that knowledge to incoming engineers.

Psychosocial factors and leadership. Transformation to scaled agile framework environments requires organizational changes that impact the psychosocial factors affecting the human systems in the organization. Interview participants agreed that the communications between team members increased trust, improved understanding, transferred knowledge, and supported personal feelings of value within the organization. Participants all agreed that constant change presented a high probability of losing the knowledge vital to successful project completion.

All participants had significant comments concerning leadership, although

leadership was not an expected theme based on the interview questions and the study focus. There was a substantial impact on leadership created as a result of the transformation. The organization restructuring and transition from command and control to servant leadership transformation created a significant impact that had a destabilizing effect on management. At the organization level, the lines of communication disconnected when teams had self-autonomy, and middle management was not given a clear role in the transformed culture. Individual teams reported having some identical situations, but received different directions on how to handle the situation, depending on leadership.

Participants understood the transformation was more than just throwing more money or more people at transformation issues to fix problems. The company management would have to take significant interest in the transformation, get out of their culture, and truly live by the scaled agile principles. The focus to get teams coordinating was constant. Respondents found confusion with program management having to be involved in every facet of the product development lifecycle and too many different opinions and lack of synergy. Lack of synergy led to competing priorities and ambiguities with ineffective leadership. This perspective represented a conflict of wanting leadership and wanting to be autonomous, which indicates the implementation may not have provided clear role descriptions and training**.**

Awareness and new possibilities. Transformation regularly brings chaos, and without enough training, anxiety creates negative perceptions. Participants felt there was not enough discussion or preparation about the transition, and some were still asking

what changed? Participants felt management did not care about SAFe. The information did not get flowed down, and the personalities of the leadership affected strategies. Participants liked that it could decouple the management decisions and let the teams make decisions.

Teams felt the management chain did not provide concern and awareness when new hires from outside the program joined the group (see Appendix E). Participants experienced personality conflicts and adversarial opinions. Respondents realized that digging in as a leader and understanding your team would be crucial to the success of the transformation. Interviewees realized it was more important to get team buy-in, rather than saying we are going to do it and move out.

Information changes people working together and creates new possibilities across boundaries. Teams discover how coordination occurs in different kinds of systems. All interview participants agreed that coordination directly impacted the schedule. The transformation described a different mindset for individuals and teams. Teams found the many different opinions and lack of synergy across boundaries to be a challenge. Participants felt there were too many competing priorities, and communication between teams could be a challenge. Some participants felt people were stuck in their ways and would not be open to collaborating.

Most interview responses declared that structure and coordination provided the means to cross-communicate with other teams. Only one participant felt the coordination practices were the same across teams. Cross-boundary coordination was declared to allow teams to see what other teams were doing and react to the system instead of their separate

team. Participants felt this leads to more value--especially when interacting with other teams. Participants felt every team had its schedule, and that schedule must coordinate with every other team schedule. Teams identified to having different dependencies in their plans and having each team in their little silo would fail all teams.

Globalization, changes, and differences. The globalization of significant projects has challenged the opportunity to work in proximity and ease of coordination, and the evolution of digital tools has removed most of the previous obstacles to virtual team coordination. All participants felt it was better to see someone and talk with them face to face, but the geographically separated units had to find alternative communication methods. Some teams felt that it was easier to work their schedule as a team and not use email or other digital media. Interviewees indicated that some people are annoyed by the meetings required for schedule coordination and may attempt to fall back into a waterfall method. All respondents agreed that PI planning created the opportunity to gather everyone's thoughts and often find someone may have a better idea. The transformation created a rapidly changing environment, and the conflict to get things completed created new challenges.

The impact of the changes and delayed clarity of the differences caused delays and rework that was not well received by the team members. When a team is not working dependencies in coordination with the higher schedule, it causes conflict. It blocks production completion, but the cross-boundary coordination between teams helps to identify anything dependent on anything else. All participants had a similar comment that the difficulty in completing coordination was the need to coordinate with the objectives

of the team and the organization. Coordination is a prime tool for sound decision making. All respondents agreed that quality was affected by coordination, and there was a definite link between good coordination and good quality. Participant comments declared that ineffective coordination results in a delivered product that was rushed or had preventable defects.

Interview comments included character descriptions, such as inexperienced, personalities, age, new team members, and conflict. Some respondents summarized these characteristics as the human element, conflicting personalities that cause team friction. Participants reported that some personality types do not like to talk or interact with others, and when these are subject matter experts that can be critical. Some more extreme responses reported personality clashes were also a potentially serious issue with some teams. When personality clashes affected performance, it was necessary to turn the matter over to management.

People, the system, and social capital. Participants commented on having too many different opinions and a lack of synergy that created competing priorities. Interview respondents had an issue with ambiguities and placed the problem on ineffective leadership. In a conflicting response, respondents repeated that it helps if you have a diverse team because it removes the underlying biases that people carry with them into the company. Participants extrapolated these observations to include the situation. Participants said it was necessary to make the work environment more satisfying and have people know they have a support system, a sense of security, and belonging. Additional participant comments on diversity saw a diverse team could allow decisions

with more perspective and make more system-based decisions and less subsystem-individual-based decisions. All participants agreed that PI Planning provided the opportunity to have a technically diverse and open discussion that allowed all views and resulted in innovative ideas.

Social capital refers to those factors of an effectively functioning social group. Social capital includes interpersonal relationships, a shared sense of identity, shared understanding, common values, trust, cooperation, and reciprocity among the group members. Social capital explains the performance of diverse groups. The implications of such an environment are significant and provide excellent value to any team. The benefits of positive social capital align with the concepts of cognitive diversity and with the transformation objectives. Figure 3 represents the relationship among the key themes found in the analysis**.**

Thematic Analysis of the Data

A step by step method of conducting a proper and rigorous thematic analysis exists in the literature. I followed Braun and Clarke's (2013) guidance and reviewed the data multiple times to develop a thematic map (Figure 4) and refine the themes. Definitions and naming of the themes happened in conjunction with the thematic map development.

In the following thematic analysis, I include direct quotes from participants. Shorter quotes enhance understanding of specific interpretations, and more extended quotes provide a clear view of authentic texts.

I reviewed each of the 12 interviews several times during coding and analysis. During each review, I continued to group the vast amount of critical words initially highlighted. The groupings lead to several major themes that were repeated by most of the participants. Figure 5 illustrates the cumulative theme frequencies of occurrence by the participant.

Six themes appeared across the data collected from all 12 interviews. Cognitive diversity, cross-boundary, transformational leadership, and knowledge transfer are the four themes that were most common among the 10 themes. Cognitive diversity, cross-boundary, transformational leadership, and knowledge transfer are the four themes that were most representative of the 10 themes. The four themes captured the four transformation factors identified in the literature review, which included (a) large scale to scalability, (b) communication, collaboration, and coordination; (c) psychosocial influence; and (d) importance of scaled agile framework and coordination to business. These four themes overlap or derive the remaining themes.

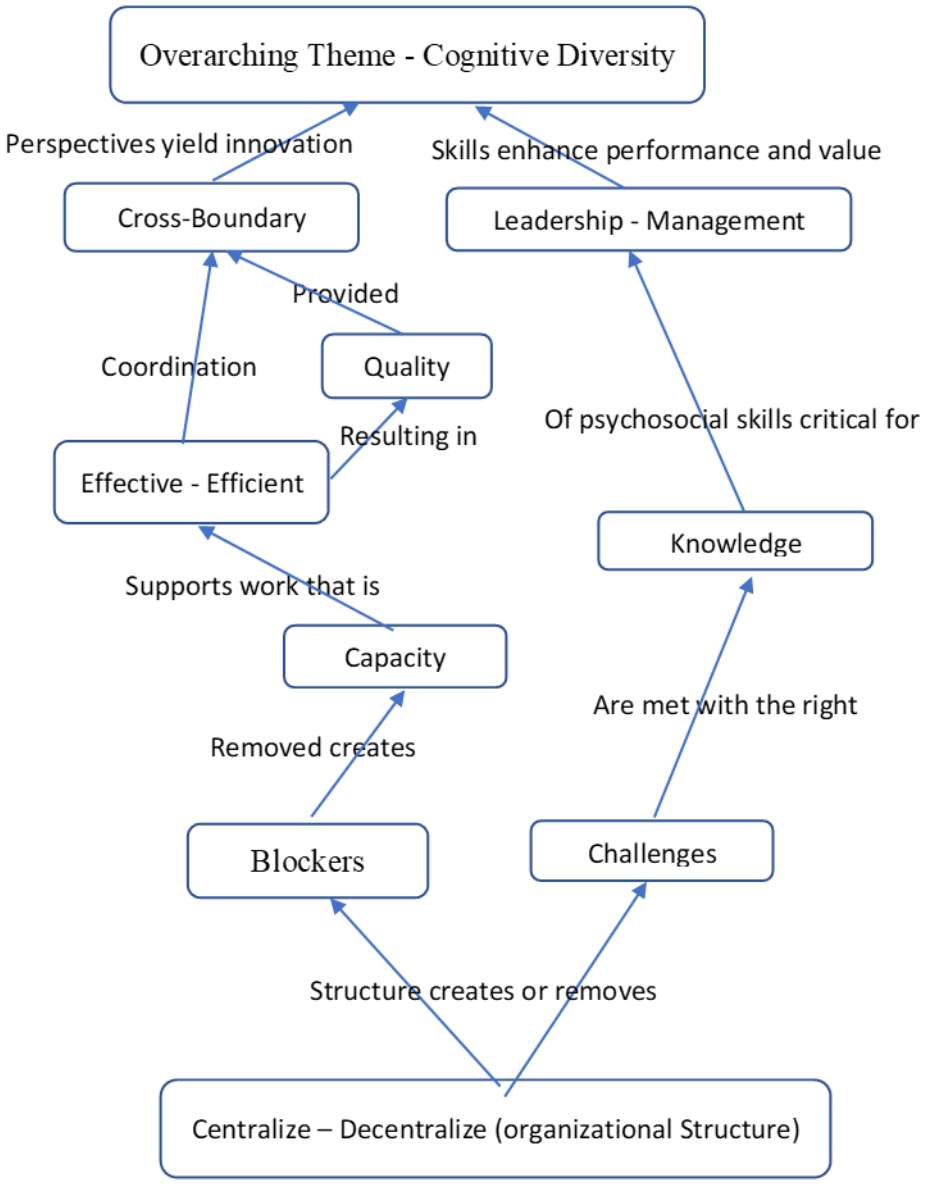

Figure 4. Thematic Map Themes and Relationships

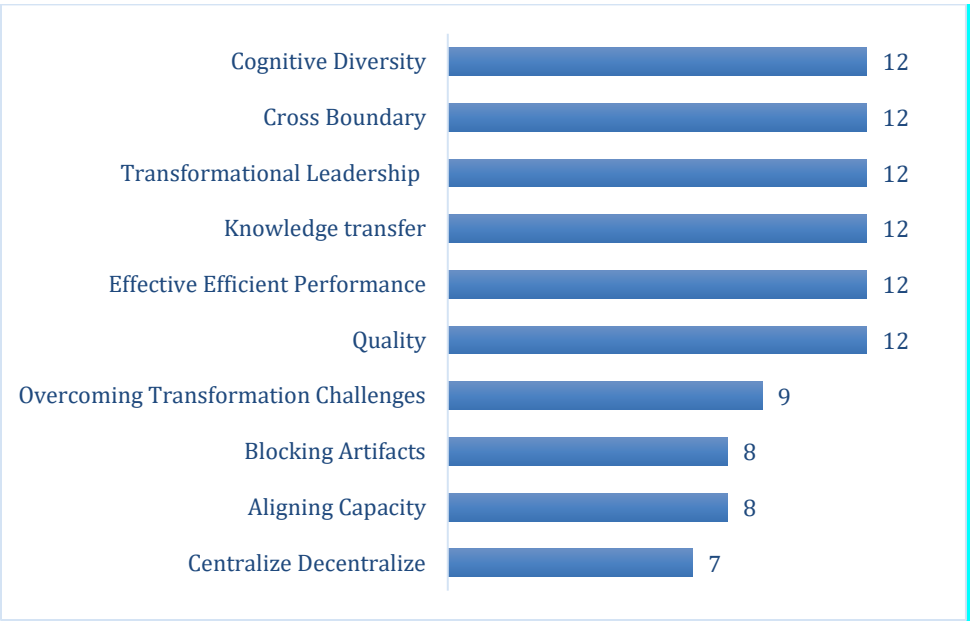

Figure 5. Theme frequency of occurrence by participant.

Cognitive diversity. This theme refers to the inclusion of people with different styles of problem-solving who offer different perspectives. They think differently and come from varied backgrounds, such as separate disciplines, different project experiences, age, culture, and training. This concept extended to cognitive training, where one group may present a problem-solving experience to another group and introduces an alternative method to view and solve problems. No participant used the words cognitive diversity. However, through the analysis I was noticing a theme that suggested that the participants were describing cognitive diversity. The conclusion that cognitive diversity was an overarching theme was derived from unexpected volumes of responses relative to leadership and surprising comments about different age group characteristics. These comments were perceived during interviews to be strongly felt comments from the participants but did not provide a clear image of the participant's intended response. The

section above that identifies the discrepant cases were instrumental in identifying the deeper meaning behind several comments on different age groups within the agile release trains. The comments about different age groups within the study and the transformation leadership misaligned with the interview questions. The continued effort to understand how these responses revealed themselves during the interviews required investigations into non-technical and non-engineering disciplines. During this added research, the concept of cognitive diversity emerged through the literature. Cognitive diversity is defined here as differences in perspective, specifically how individuals think and engage with new and complex situations. Answers from respondents appear as stereotypical comments when viewed individually.

P5, "I think getting people to change what they used to, to jump into something that's not familiar. I've definitely seen, on my program, that engineers are reluctant to change." P9, "It seems like the more coordinated teams, are a tighter-knit team, have more of a friendly relationship, a more cordial relationship with all of the members." P4, "Nothing against the younger generation, but it's just technology, they don't want to do anything in person anymore." P1, "I think part of that is just the nature of younger team members not to have as much to say." P6, "You have to know who you bring you to your team to see how they're going to fit in with the group." P11, "One team is almost composed of classmates from the same university, which helps it along, but they tend to have parties at each other's place. They tend to go out to lunch. They also tend to work together in general better." When it seems, there are these stereotypical character assessments based on age, P10 upsets the entire direction of the responses. It identifies

that there is something more significant at the root of these responses. P10 responded, "I have another team that is very tightknit like that, socializing after hours, having special nights out, but again, I think it's case-by-case. So, it's, it's, it varies. If there, and I can't explain, because one team, I'm gonna say has the more senior members in it, compared to some of the other team members who are younger than my son." These characterizations and the uncomfortable responses about leadership and management combined to identify cognitive diversity as the cohesive theme behind the participant responses and as an overarching theme that may have some answers to meeting increased performance and innovation objectives.

Cross-boundary. This theme relates to the cross-boundary data collection through vehicles such as interviews, observation, and organizational, historical data within the study environment. Interviews captured participants' perspectives in the transforming environment of the scaled agile framework and provided a better understanding of the coordination methods involved in that transformation. Teams that worked in silos for over 20 years had the impact of a rapidly changing work environment and significant process changes causing chaos as they tried to adapt to the new organizational structure and processes. Interviews captured participants' perspectives in the transforming environment of the scaled agile framework and provided a better understanding of the coordination methods involved in that transformation. P8 offered, "It seems like, instead of having the silos, the goal was to have more cross-communication between teams." P4 addressed one of those changing processes in the response, "Trying to get into that framework where we know that our work is dependent

on other people and vice versa is a big thing for us because it helps to minimize the timeline." P11 saw, "too many things happening at one time" and cross-boundary coordination would provide synergy. P11 felt cross-boundary communication would not occur without scrum of scrums coordination. The scale of current projects requires multiple teams working independently to achieve individual objectives that merge into a higher cross-boundary goal. P8 commented, "in theory, we have one PM for release as well, but then there's nobody coordinating across all the devices." Organizational structure can change to meet these flows, but teams need a process that allows for ease of coordination between those boundaries that seamlessly bring the individual efforts together. Cross-boundary coordination is a cultural change that challenges all the teams involved in the transformation.

Transformational leadership. This theme refers to more than who is in charge. It assumes the perceptible transformation from command and control leadership to servant leadership as the organization transforms into the scaled agile framework. It is a primary response from all participants and an unexpected theme of the study. P8 was looking for leaders from different teams to collaborate and talk about dependencies. P12 saw everything was already the highest priority, and no leadership was ranking the order of execution. P12 found this to be ineffective leadership where the competing priorities transfer to the individual teams. P5 said, " I think getting people to change what they used to, to jump into something that's not familiar. I've seen, on my program, that engineers are reluctant to change." P8 identified a direct link between individual team participation and commitment from leadership and said, "it kind of, then really depends on who your

leadership is." Several participants felt better leadership development was needed. The transformation of leadership style from command and control to servant leadership was extensive, and there appeared to be a lack of understanding of how the conversion was changing roles and responsibilities of leadership. P3 echoed this in response, "It puts the manager in a servant leadership position, which if you've done 30 years of command-and-control, I'm just going to guess that there's a little bit of impact to your psyche and what is this servant leadership stuff?" P10 identified personality conflicts and understood that management was the only source to resolve these issues. Leadership and management training require addressing these conflicts in the new environment created during the transformation. Teams were evolving, and new approaches were needed to leverage the transformation to achieve desired performance and innovation objectives. P4 said, "we were not getting management support. So, when you don't have that backing from the people directing you, you're not going to be successful, and people aren't gonna believe in it."

Knowledge transfer. This theme refers to participants' experience and understanding of processes and the relationship between sections of a product. The identification from all participants that there was no open movement of knowledge between people and teams was a universal concern. Participants felt the knowledge remained tribal knowledge, and those with this knowledge were not available to support new members to become efficient team members in a shorter timeframe. P11 felt, "Cross coordination between both PI planning and the different things; like PE-PM things that we have or PM-PO, just to make sure that people that have this wealth of knowledge are

getting it out." P5 said, "We have over 100 different developers, and every one of them has a different knowledge base." P5 said, "Sharing that knowledge, instead of having to find out by accident, would be great." If we accept knowledge management as delivering the right data to the right people at the right time, then this is a critical theme to the coordination process in a scaled agile framework.

Effective-efficient performance. This theme refers to a variety of definitions from participants. The central theme from all participants is that effective and efficient processes allow teams to complete tasks in a framework that supports their intended schedule and cost estimates. P3 provided an interesting perspective with the response, "The lack of awareness is used as the excuse why something doesn't work versus really searching stuff out to become aware of it and so the concept of our cost is varied." P12 was supportive of P3 with the response, "Without awareness upstream and downstream, dependencies cannot be identified." P10 said, "You extract different reports to see how things are flowing or progressing." All participants referred to the effectiveness of communication tools and identified the variance of specific tools was dependent on the proximity or personal backgrounds of the teams. Proximity was expanded by P4, who said, "Unfortunately, person to person isn't always the most effective anymore." Most participants saw a direct relationship between awareness and effective collaboration, such as P12, saying, "awareness was the foundation of effective collaboration."

Quality. This theme refers to several definitions of quality. This theme will refer to quality as the first-time delivery meeting the customer requirements and reducing or avoiding any rework. Participants had varying definitions, although all focused on the

product delivered and the customer approval of that delivery. P11 provided a causal relationship for the bad quality in the response, "At some point, it was decided that we should centralize everything and run everything through the PMs so that they were-I'd almost call it micromanaging the squads, and I think this led to problems. It just leads to poor quality." P2 said, "once you interrupt workflow it takes a while to get back into that, so that affects the quality of our outputs" and P6 added, "We know who is going to work a certain part of it so that when we complete the presentation to the customer, we know that we have a completed project with no errors on the end." The implications between coordination and quality ran consistently through all participants. P11 may have summarized it by saying, "Coordination especially helps when anything is complex, and that is almost everything. Nobody knows all the systems."

Overcoming transformation challenges. This theme is about overcoming transformational challenges and gaining participants' commitment to adapting to the scaled agile framework. Challenges come in the form of funding, structure, work environment, and changing processes. Workflow and value identification is a continuous challenge in this transformation environment. P1 indicated that challenges could come from any direction when responding, "We seem to have a tool for everything that we want to do. If there is a challenge, it's not that the tool doesn't work, but there is so much to learn that it takes a while to be proficient with all the tools that you need to be proficient with." P7 stayed focused on the schedule as a challenge and stated, "Staying, coordinating, keeping the schedule in everyone's mind is so key." P2 considered each department having its silo a challenge, and P3 felt there was confusion with the program

management on how all the entities were involved in the development cycle. P9 saw competing opinions, and leaders had to understand the variances, while P12 saw the competing priorities as the result of ambiguities.

Blocking artifacts. This theme refers to those issues that act to prevent teams from completing assigned objectives. These obstacles occur throughout the system and are called blockers. Blocking mechanisms can occur as people, environments, and organizational structure. Themes related in these instances. P8 said, "If you need to show management what we're doing, or that there are things that are blocking your success because you have all these pop-ups, you know, let's document this together and find a way that it's not too much of a burden for you, but in a way that tells your story." There is a sense that leadership may be considered a blocking mechanism in some circumstances. P6 approached the environmental conditions and the human in the loop perspectives when responding, "If we don't identify what people are doing, there could be overlap, everybody can be working the same issue, and the full project never completes." People working toward an objective could be the blocker in this instance.

Centralize and decentralize. This theme refers to organizational structure. Transformation to the scaled agile framework includes reorganizing the entire organizational system. Participants P2, P4, P8, and P12 all referred to the centralized and decentralized structure. P12 stated, "Without awareness upstream and downstream, dependencies cannot be identified." P4 approached the theme from a slightly different perspective in the response, "We need to continue changes so we can be more 'SAFe like', otherwise people aren't going to take it seriously, with the other person."

Aligning capacity. This theme refers to participants' concerns that the resources needed to meet demands will not be available. The resources can include funding, people, or facilities. Most often, this theme is identified by participants using the word people.

People was the fifth largest word identified in the word cloud of participant responses. The term, people, was used in several perspectives within the 304 times it was detected. P2 used people to refer to the knowledge that was necessary to transfer concepts into action in the response, "It used to be separated, and things used to get done without the knowledge of the people upstairs versus the people downstairs." P4 and P5 referred to people knowing what other people are doing, so they could help each other without using resource capacity in redundant activities.

Triangulation

Yin (2016) called triangulation a frame of mind, and it had the potential to identify conflicting data. This opportunity to collect data from multiple sources allowed the identification of converging responses from the data (Yin, 2016). Varied sources of data collection provided different perspectives on the case data under investigation. (a) a semistructured interview protocol (see Appendix A), (b) casual field observations kept by the researcher throughout the data collection process (see Appendix B), and (c) organization historical materials (see Appendix C). Intersecting the data sources improved the quality of the study and provided a coordinated reflection of the data (Yin, 2016). Data collection supported by handwritten notes appears on each of the prepared templates used for data collection. Handwritten notes supplemented the audible recordings and transcriptions from the interviews (Saldana, 2016); orthographic

transcriptions provided a contextual insight into nonverbal behaviors that enhanced the comprehensive documentation of participant interactions. The casual observation protocol provided a template to document observations without the need to interface with individuals directly. It was necessary to add copious handwritten notes when the scale system proved to be incapable of capturing the details of the observations. Review of the organization surveys and questionnaires began with extensive written notes to capture instant impressions of the researcher. Further analyses of the organization historical data employed the use of the handwritten notes. The organization data obtained at the beginning of the transformation completed almost two years before the collection of the observations and interviews.

The casual observation protocol provided a template to document observations without directly interface with individuals. It was necessary to add copious handwritten notes when the scale system proved to be incapable of capturing the details of the observations. Review of the organization surveys and questionnaires began with extensive written notes to capture instant impressions of the researcher. Further analyses of the organization historical data employed the use of the handwritten notes. The organization data obtained at the beginning of the transformation preceded this study by almost two years. Many of the results in the early organizational data use some of the key scaled agile terms that indicate a lack of real understanding of the words. The comments reflect that more training is needed, and this theme continues into the current interviews.

Too many meetings continued to be an issue identified in the early questionnaires and repeated in the current interviews. Casual field observations saw substantial

variances in the amounts, organization, and value of meetings and indicated the initial complaints were not always valid in ongoing operations. Inadequate preparation for meetings was observed in several observations and would lead to the dismissal of many of the complaints involving meetings.

The comments on authority is an example of an interpretation of the analysis outcomes Loss of authority assumes someone knows the value of that authority and can define the difference between the two. The transformational change from command-and-control to servant leader would leave the impression of lost authority. However, in the transformation, teams are subsequently given authority to make more significant decisions at the team level. This theme was carried into the current interviews and expanded into social capital comments. Cross-boundary interactions added to the questions of authority and leadership.

A question in the historical survey asked how often the respondent participates in the retrospection. Historical information shows that there is small participation during PI planning. The primary participants appeared to be the product manager, business owner, scrum master, and architect. Responses in the current interviews suggested some people are not as interactive and do not participate. Lack of interaction during the early introduction of the scaled agile framework transformation changed over time. The lower participation from initial respondents may infer a failure to achieve buy-in. The first data shows an, us versus them, picture.

The question about a single change that would improve organization performance and have significantly different responses varies from a questionnaire done today. The

issues, buy-in, and eliminate redundancy are still relevant. The most apparent issue that continues from the earliest surveys is the one on pop-ups. Perhaps the most significant issue that continues is getting buy-in. Many of the results in the initial organizational data use some of the key scaled agile terms that indicate a lack of real understanding of the words. Lack of terminology reflects the comments that more training is needed, and this theme continues into the current interviews.

Summary

In this chapter, I presented the data and results for the qualitative exploratory single case study to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework. The overarching question of this study is, how does a large organization transforming to scaled agile framework use coordination methods to support software and systems engineers to potentially improve the success of the implementation of the scaled agile framework? The first research subquestion was to address how to achieve coordination in a scaled agile framework environment. The second research subquestion discussed how coordination increased the successful transformation to the scaled agile framework and focused on coordination effects on proximity, uncertainty, software, schedule, performance, quality, and decision making. The third research sub-question addressed how the coordination process impacted interaction between members of the project to reduce failures. This sub-question focused on coordination strategy and project coordination, the effect of communication between members to reduce failure, the value of social capital, competing

objectives, analysis, face to face coordination, team member coordination, and human to human interactions.

The data focused on the three research subquestions. the first area of focused was to address how to achieve coordination in a scaled agile framework environment. Data indicated that coordination occurs in varied contexts and varied methods. Personalities were prominent when determining coordination methods and awareness provided a decisive factor for effective coordination. The second area of focused was on understanding how the coordination process impacts the interaction between members of the project to reduce failures. This area of questions focused on coordination effects on proximity, uncertainty, software, schedule, performance, quality, and decision making. Data collected indicated proximity preferred close, but global projects required alternative solutions. Silos were still a concern of many, and inclusiveness was a more significant issue than previously. Leadership roles and fit emerged as discussion topics. The third focused on how coordination increases the successful transformation to a scaled agile framework, the interaction between members of the project to reduce failures, the value of social capital challenges coordinating between team members, standard practices, and competing objectives. The over-arching focus was on the human to human interaction. Data from participants indicated that person-to-person collaboration was critical to success; knowledge transfer resided within that collaboration, and social capital was a crucial multiplier of success that was effective concerning the teams' cognitive diversity.

Data and findings from this chapter are interpreted in Chapter 5 to compare to results in the literature and the conceptual framework. Limitations are refined and presented. Recommendations and implications for positive social change are introduced.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this qualitative exploratory single case study was to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework. My study involved obtaining information about coordination methods using an exploratory, qualitative case study. The conceptual framework of general system theory and coordination theory created a foundation for my research and a better understanding of interactions and relationships that involve coordination as the binding factor during transformation. My conceptual framework of these theories provided boundaries and a better understanding of how coordination methods work during the implementation of a scaled agile framework to improve success.

I conducted the study to understand both positive and negative issues in applying coordination methods within a highly technical organization, transforming it into a scaled agile framework. Scholarly research and knowledge from Amici and Bietti (2015), Dikert et al. (2016), and Strode et al. (2012) identified a gap in the knowledge of how projects utilize coordination to implement scaled agile transformation. There is a lack of understanding of efficient and effective coordination methods that lead to a successful software development process. The gap in knowledge about coordination that is required to support a successful transformation to a scaled agile framework is the research basis for this case study. Results and findings from the study appeared in Chapter 4. The interpretation of those results in this chapter are (a) within the context of prior research, (b) explained considering research limitations, and (c) lead to recommendations for

further research and implications for professional practice. Scholarly knowledge and research may increase from the insights gained from this study.

Interpretation of the Findings

The literature review indicated large-scale projects need more coordination, and a systemic view of coordination is missing (Dikert et al., 2016). Amici and Bietti (2015), Dikert et al. (2016), and Strode et al. (2012) identified a gap in the knowledge of how projects achieve critical coordination. My research indicated there is a problem associated with a lack of understanding about factors of efficient and effective coordination methods that support successful software development processes.

Various coordination methods have indicated their emerged in this study that are applicable to supporting transformation methods in large-scale development organizations. Organizations may benefit from a better understanding of these coordination methods used during transformation.

The findings of my study confirm or extend the knowledge currently available. This section compares the current literature reviewed in Chapter 2 and break out those findings based on the key themes found in the analyses. I provide evidence obtained through the 12 participants interviewed and bounded in the three questions supporting the research question.

The conceptual framework of this study was a combination of two theories about how people and systems interact. In coordination theory, Malone (1988) argued that people and computers associated with rapidly growing numbers and required an increase in flexibility and adaptability. Organizations transforming to scaled agile framework need

knowledge transfer, changing mindset, and cultural shift to transform to scaled agile framework (Korrapati & Nair, 2010a; Wiewiora, Trigunarsyah, Murphy, & Coffey, 2013). My findings confirm the relationships between people, technology, and knowledge transfer. General system theory provides addressed organizational structure and interrelationships between structural levels involved in the transformation. The disconnect between levels of the transformed organization was evident in my study and expressed in several interviews. The finding of this study confirmed that knowledge is modified and eliminated because of increasing empirical knowledge—specifically human forms of cognition, dealing with man's everyday world (von Bertalanffy, 1967).

Coordination challenges in large projects include a lack of interaction between participants, miscommunication, and loss of knowledge (Dingsoyr et al., 2016; Eriksson & Stanton, 2015; Xu, 2011). Individual participants made many comments that movement of essential subject matter experts and reorganization changes had severe impacts on knowledge transfer from subject matter experts that transferred vital information to new team members. Teams need to communicate, use relevant knowledge, and produce better outcomes (Dikert et al., 2016; Strode et al., 2012; Pemsel & Wiewiora, 2013). As the size and complexity increases, knowledge transfer becomes more difficult (Butchibabu et al., 2016; Metz et al., 2015; Read & Briggs, 2012). Rao (2015). All 12 interviews confirmed this finding. Dingsoyr et al. (2016) synergize this theme that knowledge work lives in an innovating environment where social interaction provides a shared context and where coordinating team members are vital to project success

Within agile and the scaled agile framework methodologies, the coordination and synchronization of events across a diverse range of independent and interdependent teams become critical to the success and productivity value of any significant development (Farrow & Greene, 2008; Lindsjorn et al., 2016; Maranzato et al., 2012). Fry and Greene (2007) saw the transformation as the means to create a significant and fast agile transformation. Cross-functional teams required a ground-up redevelopment redesign.

Xu (2011) felt that boundary spanners or people who would work across boundaries facilitated cross-boundary communication. Interview participants identified these boundary spanners as architects and product managers. Malone and Crowston (1994) identified the need to look for analogies of how coordination occurs in the different systems. They identified cross-disciplinary coordination as managing dependencies between activities. Interviewees confirmed the coordination and exchange of dependencies. Cross-boundary opportunities for new development and new ideas is critical to success (Malone & Crowston, 1994). Most of the literature research focused on the higher level or organizational level of communications. Interview participants in this study offered more details. Responses from the interview indicated the instances where vertical communication facilitated cross-boundary efforts (Xu, 2011). In this study, teams dealt with tasks and established their norms, values, and time frames, as postulated by von Bertalanffy (1969). Transformation of the organizational culture and the ability to cross boundaries requires the organizational culture change (Dikert et al., 2016). The cross-disciplinary boundaries are where opportunities occur (Malone, 1988). In the study,

teams that indicated improvements resulting from the transformation pointed to this cross-boundary and cross-discipline area.

Agile focuses on people rather than processes and is a principle of the Agile Manifesto (Cockburn & Highsmith, 2001). In organizations where command-and-control leadership has been the method for many years, scaled agile transformation can cause great confusion and disruption (Khmelevsky et al., 2017). Participants in this study reported conflicts occurring wherever scaled agile was fostering the ability to accommodate change without a structured approach (Khmelevsky et al., 2017). Drury et al. (2012) agreed with Fecarotta and found that conflict in priorities and competing requirements can often lead to team confusion. Both studies found decisions based on the unstable availability of staff where people pulled from one group to another. Interview participant's comments confirmed the literature with responses that too many different opinions and lack of synergy existed across boundaries. Participants identified there were too many competing priorities and ambiguities as a result of ineffective leadership.

The terms evolve, and the situation becomes critical terms when related to the ability of the humans in the loop to manage and adapt to changing technology. Respondents reported that when a key member leaves the team, it results in team impacts and not completing an iteration on time. Frustration results from these team destabilizing factors, contextual differences, and team members begin to rely on others to make decisions. Xu (2011) examined agile projects applied to large software projects and asked how coordination could help in the transition. Interview participants felt the issue was so many ambiguities caused by ineffective leadership.

Poor management represented a bad interface between the organization and the environment (Charette, 2005). Some respondents saw all management focus pushing for a financial answer to all decisions. Corporate culture plays a role in the adoption and engineering implementation that is influenced by cross-functional team participation, and top management support, having both positive and negative effects (Dyba and Dingsoyr, 2015). Dikert et al. (2016) assessed the related activities of human interaction in marketing and product management functions. A common occurrence during any change and perhaps more so during a full transformation is that of resistance to change, which can take the form of averting the need to move from a status quo to a sophisticated process methodology (Dikert et al., 2016; Vijayasarathy & Turk, 2012). Team members in this study reported seeing confusion with program management, thinking they had to be somehow involved in the product development lifecycle. The general findings from this study indicate that transformational leadership needs to create clear goals such that everyone understands their functionality within those goals (Brown et al., 2013; Dikert et al., 2016).

Transformational leadership plays a pivotal role in successful transformation, and management has numerous opportunities to create an inhospitable work environment that will increase turnover, withhold adequate training, and defocus the basic principles that will make the transformation successful (Charette, 2005). Participants in the study confirmed work environment obstacles and identified the leadership roles' personalities as factors affecting the teams' strategies. There were different directions, depending on the leadership team. Complexity adds to the fast-changing and uncertain environment,

and there are accompanying changes in management roles and procedures (Dyba & Dingsoyr, 2015; Hui, 2013; Pisano et al., 2015). Comments from the interviews included suggestions that leadership receives training about the transformation and that leadership was too removed from the operational level to be either productive or supportive. A typical concern that crossed boundaries was the lack of adequate inclusion of mid-level management was not adequately included in the transformation. Most respondents felt this caused negative consequences from that level, continuing to do things the way they always did. Because they were the subject matter experts, they were not available to provide technical transfer of that knowledge.

This study confirms current literature that combining social, technical, and organizational elements can become even more complicated in a global society where complexity increases due to culture, geographical locations, languages, and cognitive concepts (Bass, 2013; Brown, Ambler, & Royce, 2013; Gallardo et al., 2013). The study objective to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework as a critical success factor for successful transformation is confirmed. The findings of this study agree with previous results that it is essential that each person understands the other and that cognitive synchronization occurs and assists communication between different participants and justifications (Metz et al., 2015). The synchronization relationship that depends on the coordination and actions of the team members, referred to as group awareness and awareness, was a significant response from all interview participants.

Eriksson and Stanton (2015) explored what happens when communication breaks down in complex systems. Across all interviews, there was a feeling that awareness gave the teams some control over their environment. Comments from interviews demonstrated employee concerns that management did not provide the awareness and that awareness disappeared when new hires, especially those from outside the program, were brought into the team. Eriksson and Stanton (2015) showed there is a need to escalate cognitive activities as the system becomes more complicated. Larger projects require attention to inter-team coordination, and independent teams' goals differ in coordination methods (Dikert et al., 2016; Farrow & Greene, 2008). The findings of this study confirm coordination is a significant challenge to transformation (Brenner et al., 2015; Gill, 2015; Kudaravalli et al., 2017). The connection between coordination theory and coordination technology demonstrated one must have some idea of the goal and the participants involved to align these synergistic traits (Malone, 1988).

A primary goal of the transformation to a scaled agile framework is to increase innovation and performance. The general system theory concept of evolution and innovation coordinate the focus on previously considered ideas in different fields and finds the commonality between them (von Bertalanffy, 1969). Both cognitive science and coordination theory focuses on problems that are already regarded as separate fields (Malone, 1988). The dynamic growth of electronic media brings together and coordinates people with diverse knowledge and skills. There is a cognitive presence across all aspects of organizational transformation. Amici and Bietti (2015), Dikert et al. (2016), and Strode et al. (2012) identified a gap in the knowledge of how projects use coordination to

implement scaled agile transformation, and there is a lack of understanding about efficient and effective coordination methods that lead to a successful transformation. This study identified discrepant cases that may help to answer questions on the gap in knowledge. Respondent comments confirm that understanding the human-machine cognition interface within those development systems is critical to any possible success (Malone, 1988; Malone & Crowston, 1994).

The recurring theme of cognitive diversity was evident throughout the responses. Respondents perk up and work a little harder when their ideas receive attention. Transformation to scaled agile framework environments requires organizational changes that impact the psychosocial factors affecting the human systems in the organization. All participants added comments about the cooperation and involvement of the team, about inclusiveness, and identifying team member value. Inclusiveness fits into the cognitive diversity theme and supports the higher value of cognitive diversity as a solution to several transformation obstacles.

My study identified an effective coordination method using cognitive diversity within an operational context. The findings of this study are consistent with much of the current literature, and collectively recognize that an effective coordination process with strong interrelationships among people and processes will help to reduce failure rates and improve the success of large projects. The well-known relationship between effective coordination and successful transformation remains valid based on the results of my research. Moreover, my research identified the concept of cognitive diversity within technical teams, applying the concept to the transformation to the scaled agile framework.

The human system may involve incentives, motivations, emotions, and cognitive processes that do not exist in the technological system (Malone & Crowston, 1994). In this study, I confirmed that coordination methods can support the successful transformation and implementation. In this study, I uncovered a link between the technical teams and transformational leadership that surfaced in the interview responses and that holds the key to closing the knowledge gap identified in the literature.

My research revealed that team members were looking for avenues to get leaders from different teams together and talk about the problems and dependencies. Coordination is not second nature to these leaders, and most information does not get flowed down. Teams identified the personalities of the leadership roles as factors affecting strategies. The interviews revealed that management must take significant interest in the transformation, get out of their culture, and live by the SAFe and agile principles. Digging in as a leader and understanding the team constituents had to become a priority. Coordination processes impact humans, organizational structure, evolving methodologies, information transformation, and adaptation (von Bertalanffy, 1969).

Transformation to scaled agile framework environments requires organizational changes that impact the psychosocial factors affecting the human systems in the organization. Respondents in the study felt the management chain did not provide necessary awareness. There was confusion with program management and involvement in product development. The element that was defined to be missing in the transformational leadership was a legitimate sense of cooperation and participation, inclusiveness, and identifying team member value. Interview participants stated

succinctly that transformational leadership must learn to understand the people involved in the coordination and feedback dynamics of the team.

The new environments evolving during transformation present too many different opinions and lack of synergy across boundaries. There are also many competing priorities, too many ambiguities, and incongruent team leadership relationships. Part of building trust and helping people understand in the transition is having balanced conversations and being open and honest. Having a free exchange of ideas and knowing what teams have needed knowledge facilitates efficient coordination and leverages alternative perspectives. The human element, conflicting personalities, misaligned transformational leadership cause friction and lost innovation. Rapidly changing environments and the conflict to get things completed in new organizational structures and cultures creates a leadership dynamic that challenges all leadership positions in the transformation. The success of those systems involves the understanding and structuring of an organization to support the human psychosocial knowledge and helping those needs can create a more cohesive work environment with greater flexibility and adaptability (Gordon et al., 2013; Shih et al., 2013).

Because of different personalities and different levels of understanding, you cannot have a cookie-cutter for people. An obstructive theme between leadership and teams in situations was confirmed to be where cognitive diversity was absent, or leadership was untrained in leveraging alternative disciplines and perspectives. This misalignment appears to represent a gap in the understanding of SAFe and how autonomous teams operate within the organization. This dynamic confirmed the response

from an interview participant that the older knowledge presence reference worked the way things used to be. Other participants commented on the team's younger members not being familiar with anything other than books, or only interested in the digital world. The discrepant participant referenced the group that was socially interactive and identified that group as very senior members of the organization. This discrepant data caused the introduction of cognitive diversity to be directly relevant to the organization's transformation. My results were consistent with prior research. Managers and leaders need to work with disparate teams and be able to communicate clearly with all. Communication among the different and technically diverse team members is recognized as a new challenge if people are stuck in their ways and aren't open to collaborating. Knowing that there is a support system that values all perspectives gives the team members a sense of security and belonging. The psychological security allows teams to make decisions with more views, make system-based decisions, and make less subsystem-individual-based decisions. The result of cognitively diverse teams is the introduction of new knowledge and innovation. There is a cognitive presence across all aspects of organizational transformation, and human functionality is a significant portion of any organizational system affected during the transformation to scale agile (Crowston & Malone, 1998; Cockburn & Highsmith, 2001; Shih, Shaw, Fu, & Cheng, 2013).

Limitations of the Study

Chapter 1 indicated the expected limitations of the study. These limitations presented the qualitative paradigm, the case study method, and organization factors outside my control. The project and organizational environment were accepted in its

natural state and may not be representative of other corporate environments, limiting the generalizations of these findings. Behaviors and setting of the specific project team studied were limited to the dynamically evolving work environment and may have limited this case study. Team coordination methods were constrained to the situation where the coordination was occurring in this study.

Research participants were under time pressures to build, test, rework, and repeat to meet demanding schedules. Limited time availability of the research participants and immediate access to the researcher impacted credibility techniques that included member checks and peer review to help ensure the dependability of the research. Researcher bias was a threat to the credibility of the study because the researcher had prior experience as a programmer and systems engineer. To protect against potential bias, I identified any preconceived bias before and after the interviews to mitigate the potential of inserting that bias into analyses. The acknowledgment that unexpected responses relative to age and leadership support the attempts to identify and reduce the introduction of bias. I was interested in obtaining data from one large-scale project in a global organizational structure and specific population of participants currently involved in a transformational activity. Limitation to one project opens questions whether other large-scale projects would have employed the same coordination methods with the same impacts.

Data bias exists where participants are concerned about the confidentiality of their responses in the interviews. Some participants may have been uncomfortable providing clear and honest answers and may bias the findings by giving answers they perceive are desired. Using the limited historical organization surveys, questionnaires, and

presentations during the initiation period of their transformation may have caused researcher bias because there was no feedback from the participants on my interpretations of these documents.

The sample size and specific population for the study represents a limitation to the study. This study focused on the population of more than 500 employees participating in a transformational development method recently introduced into the project organization. Research participants were limited to members of the project teams in transformation. Each engineering environment varies, and findings from the research, including only 12 interviews, while insightful, may not be transferable beyond the specific population under study.

Recommendations

The need for an in-depth examination of the role of coordination methods in the successful transformation of software and engineering teams from waterfall methods to the scaled agile framework has been covered extensively in the literature. Previous researchers have identified a gap in the knowledge of coordination methods implications and efficiencies during the transformation (Amici & Bietti, 2015; Strode et al., 2012). Future research should investigate how coordination methods vary at various levels of the organization in transformation. Existing data do not compare a relationship between executive and management backgrounds and attitudes on coordination method selections.

Future research could be an investigation to prevent planning misalignments effectively. Butchibabu et al. (2016) looked at coordination strategies that create effective team communication. Implicit coordination focuses on the anticipation of information or

resources that other team members may need, and the actual transfer of information is requested (Strode et al., 2012). An in-depth examination of these cases appears promising when inter-team coordination provides the means to prevent or resolve dependencies. Knowledge management is a collaboration to advance knowledge at the organization and social levels (Conforto et al., 2014). For social innovation, management has an intensive but balanced need to interact with collaboration units (To, 2016). If future research can focus on where collaboration occurs, adaptability to support the social innovation that accompanies change is possible.

A highly recommended future effort into knowledge transfer would be valuable research. My research suggested that stratifying the analysis using various demographic variables such as gender, age, and educational level. Interview participants in my study emphasized that knowing what teams have needed knowledge is beneficial, keeps you on track, and ensures you are not wasting time. The constant change increases the probability of losing the knowledge that was vital to successful project completion. Constructs are increasingly abstract, with the increase of empirical knowledge, and human forms of cognition adapted to dealing with a specific environment (von Bertalanffy, 1967).

Future research should look at human-machine cognitive relationships. Future studies need to examine the impact IT project manager's leadership style has on transformation success or failure. Future research could be in the form of a qualitative study interviewing managers and employees to measure the criteria of the project manager's success. Alternative research could be to conduct a quantitative study of the

relationship between manager leadership style and the work environment. My study identified that leadership was changing from command and control leadership to servant leadership in the transformation to scaled agile framework. Comments showed the suspicion that leadership had not received the training required to lead the transformation and make a future study on this subject potentially valuable.

The success of the transformation involves the understanding and structuring of an organization to support the human psychosocial knowledge and helping those needs to reduce resistance to create a more cohesive work environment that has greater flexibility and adaptability (Gordon et al., 2013; Shih et al., 2013). Future studies need to examine the relationships between leadership competencies and team social capital and further explore the mechanisms of social capital formation in addition to simple influence relationships. The study will need to have a central focus on how cognitive diversity influences the innovation and performance during the transformation. My study proposed a link between social capital, leadership, and cognitive diversity. That relationship between social capital, leadership, and cognitive diversity has a controlling influence over the resultant innovation and performance increase gained during a transformation. My study's findings can assist future research by enabling leadership in organizations under transformation to increase their knowledge and allow organizational success.

Implications

The better understanding of coordination during transformation to the scaled agile framework and the knowledge gained from this study is essential to developing opportunities to reduce failure rates. As discussed in the literature review, there is limited

scholarly research on the coordination employed in large-scale transformation implementation in highly technical hardware and software development organizations. My study findings confirm the critical role that coordination plays during scaled agile framework transformation. This section will identify the study benefits to theory, practice, and positive social change.

Implications to Theory

The research reviewed identified that there is little understanding of how to achieve effective coordination (Amici & Bietti, 2015; Dikert et al., 2016; Strode et al., 2012). My study's purpose was to increase the understanding of methods and relationships impacted by coordination during a transformation to the scaled agile framework.

The study was framed in general system theory and coordination theory to allow a focused analysis within the system and the time constraints. Simon and Goes (2013) advocated the case study can provide a basis that can be used for similar situations and applies to real-life situations. reaffirms and may contribute new ideas to the seminal works of von Bertalanffy (1969) and Malone (1988). The study's findings may add to the literature on coordination methods that may improve projects' success in transforming the scaled agile framework and supporting future theory development. The introduction of cognitive diversity to coordination in transforming organizations can accelerate the transformation and solicit earlier buy-in by affected employees.

Implications to Practice

Significant advancements in technology have made IT vital to most organizations' daily operations (Bush et al., 2017; Omar, Alijani, & Mason, 2009).

The firm in this study implemented the transformation to gain a competitive edge, improve competitiveness, improve performance, and introduce innovations. The scaled agile framework identifies the failure to deliver real benefits as not providing value. This study confirmed the potential of coordination in the conversion to the scaled agile framework transformation and will help businesses achieve profitability and increased market share. Findings from this study may serve to improve work environments, and may shed light on the importance of cognitive diversity in teams as an asset, as well as improving job security. As organizations embark on large scale transformation projects, leadership could benefit by understanding the importance and ramification of cognitive diversity. A greater understanding of coordination in the transforming organization and the implementation of a cognitively diverse team also has the potential to increase innovation and performance.

Implications to Social Change

Development failure rates indicated that 17% of the failed projects directly threatened the company (Curcio, Navarro, Malucelli, & Reinehr, 2018; Liu, 2013). Businesses cannot sustain these failure rates, and rapidly changing and disruptive technology is increasing competition, requiring shorter cycle times, reduced costs, and more significant innovation (Pisano et al., 2015). The consequences to businesses are marketplace loss and potentially closing the organization. The effects on humans in these

organizations are more complicated than project failure. Project failure affects employee security in the changing work environment and concern over continued career movement. Employees are faced with a chaotic situation of systemic change and confusion, even if an organization implements a transformation to the scaled agile framework.

Coordination processes during scaled agile framework transformation are not well understood. Exploration of the coordination enablers and barriers in this study provides new knowledge on a coordination method able to reduce project failure rates. A reduction in project failure rates achieved by transformation to scaled agile framework provides positive social change to the employees, provides self-determination of the team's planning, higher authority to determine their success, more significant opportunity to learn, and create new knowledge and innovations. Enhanced performance associated with increased innovation provides psychosocial reinforcement to the employees and management while increasing performance that supports business financial objectives. Cohen and Bailey (1997), Lindsjørn, Sjøberg, Dingsøyr, Bergersen and Dybå (2016), and Waldron (2017) described team effectiveness in these environments as a function of design factors, environmental factors, internal processes, external processes, and group psychosocial characteristics. Cohen and Bailey found that the type of team affects the effectiveness, and self-directed work teams have higher performance and attitudinal benefits. Performance and attitudinal benefits from self-directed work teams are superior to those from parallel groups.

Sociological factors support the expectation that high levels of skill and performance will impact practitioners concerned about career mobility and escalating

their marketability in the marketplace. Pisano et al. (2015) identified socio-economic trends as well as technological trends, change the scenarios, and create new opportunities, new businesses, and new players. The level of uncertainty caused by the speed of innovative technology, along with enormous information, introduces difficulty in analyzing and exploit characteristics for the latest framework. New customers increase complexity, and there is a social attitude in favor of transparency, openness, collaboration, and sharing. New trends defined by a combination of social, technological, psychological, and economic features are emerging in the global framework, affecting organizations and human behavior.

The greater success of scaled agile framework transformation provides positive social change by valuing people over processes (Cockburn & Highsmith, 2001). Self-forming teams and transparency provide a friendly work environment that offers employees the ability to control their future. Increased coordination offers knowledge workers a clear vision of expected business goals and a greater understanding of internal and cross-boundary team collaborative efforts. Agile teams can create a friendlier environment in which to work. The study findings provide a higher success probability of transformation to agile and scaled agile framework and present employees, managers, and leadership the benefits of the study findings. Sham, Titcombe, and Reid (2012) found the collaboration of people from different skills and backgrounds are taking the lead to understand the successful transformation to the scaled agile framework jointly. The study confirmed this set of different experiences and abilities as the overarching theme of cognitive diversity and a critical success factor to any transformation.

Conclusion

The problem addressed in this study was the lack of scholarly research and understanding of the issues using coordination and implementing organizational transformation in a large-scale technical organization. The purpose of this case study was to understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework. Study findings identified four-factor interrelationships steering the transformation. Leadership and employees that have a shared vison and shared objectives will have greater success when innovating, and improving performance, that inspires greater competitive advantage, and future growth.

Through my study I recognized that the identification of cross-boundary knowledge transfer, innovative structures in the organization, and the processes whereby leadership can guide and lead that successful transformation were critical factors not expounded on in other research. Organizations face global competition and organization survival resides in the ability to create effective and efficient learning and new knowledge creation. There is a need to bring people with different knowledge together to create new knowledge for such organizational transformations. Workforce and cognitive diversity also increased the probability of a successful outcomes.

Diverse technical teams create two distinct outcomes for knowledge transfer. The positive aspect is that it provides knowledge and cognitive learning from unique perspectives and can culminate in the creation of new knowledge. The alternative outcome is the potential conflict that is inherent in perspectives introduce by different values, priorities, or incentives. The critical factor to obtain positive benefits is

leadership's skills and training to create the work environment that fosters a collaborative team focus. The diverse thinking and perspectives are critical to innovative thinking and new knowledge creation, which results in innovation. Leadership needs to have training in cognitive learning and psychological safety to lead diverse teams to a focused and cohesive outcome. The enhanced collaboration will enhance innovation and help team members learn from each other. The process of cognitive diversity offers leadership the opportunity to support cognitive learning to create innovation, embrace diverse knowledge from the team, and create the single consciousness of the technical teams that will generate innovation and performance.

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Appendix A: Interview Guide

Interview Guide

Interview Details:

Interviewer	_____
Interviewee	_____
Interviewee Code Name	_____
Interview Date/Time	_____
Interview Location	_____
Send copy of signed consent form to participant? Address.	_____

Preliminary Actions:

1. Explain the purpose of the interview. Provide a short background of the researcher's connection to the study.

   Script

   I would like to take a few minutes to revisit the purpose and goal of the study. The purpose of this qualitative exploratory single case study was to understand the methods and relationships impacted by coordination during a transformation to scaled agile framework.

   Increasing technology constraints and sociocultural barriers are forcing information management systems to become increasingly complex for maintaining and transferring knowledge in an effective and sustainable manner. The United States spends more than $250 billion each year on development of 175,000 projects at an average cost of $2,322,000 and many of these projects fail. Information technology failure rates are near 70 percent. Software development failure rates indicate failed projects directly threatening the existence of the company. The goal of this study is to determine how a large organization transforming to scaled agile framework uses

coordination methods to provide software and systems engineers support to reduce failure rates that approach 70 percent.

I am conducting this study as part of my doctoral program. I have a background in meteorology, project management, programming and analysis, information systems, certified six sigma black belt, quality management systems in manufacturing, and services. I am a Certified PMP and Certified Six sigma Black Belt. I am a Release Train Engineer. Those roles have no bearing on my role as a researcher in this study.

2. Explain participant rights.

   Script

   Your response to my invitation to participate and your signature on the consent form, indicate your formal consent for this interview. Please note that all information will be held in the strictest confidence. This interview will be digitally recorded. I will transcribe the interview. The data collected from this interview will only be viewed by me and my dissertation committee. Please note that your involvement is voluntary, and you may choose not to answer a question. Also, you have the option to stop the interview at any time. The interview should take no more than an hour to complete. Thank you for agreeing to participate. Please sign the consent form.

3. Collect the signed consent form. Arrange for a signed and data copy to be given to the participant.

   Would you like me to send a scanned copy of the form to you? [If yes, record address for copy delivery.] I plan for the interview to last no longer than 60 minutes. During this time, I have several questions to cover.

4. Confirm that participant meets required profile.

Demographic Questions:

1. Are you employed by a company that is introducing a transformation from traditional waterfall development to a scaled agile framework development method?

2. Are working on scaled agile framework in your current project?

3. Is the transformation to scaled agile framework a new challenge in your organization?

4. Are you on one of the teams that need to coordinate and synchronize operation to make the project successful?

5. Have you completed a minimum of one project using the traditional waterfall method?

6. What is your background in software, hardware, design, quality, manufacturing, implementation, or other engineering required for successful completion of the Project?

7. Name of the organization

8. What is your role in helping achieve the project?

9. Have you been an employee in other organizations that transformed from waterfall to scaled agile framework?

10. Are you in a Management role? What is that role?

Interview Questions:
Every question will not be asked of every participant although the questions will focus on the research question and 3 subquestions as follows:
Research Question:
Subquestion 1: How is coordination achieved in a scaled agile framework environment?
Subquestion 2: How does coordination increase the successful transformation to scaled agile framework?
Subquestion 3: How does the coordination process impact interaction between members of the project to reduce failures?
Interview question (1-9) and probing questions indented from interview questions are as follows:

1. What new kinds of coordination structures are desired? RSQ1, RQ1
    a. Do you use different coordination methods in different situations? RSQ1, RQ1.
    b. What are the most effective communication coordination tools that you use? RSQ1, RQ1
    c. What success factors in coordination have you identified? RSQ1.

2. Does coordination influence team culture? RSQ1; RSQ3.
    a. Does the proximity of other team members effect coordination? RSQ2.
    b. How does awareness play a role to provide appropriate coordination support for an effective collaboration? RSQ1
    c. How does the team coordinate when discussing ways to improve performance? RSQ3
3. What challenges in coordination are linked to large-scale transformations? RSQ1, RSQ2, RQ1
    a. How can project development be coordinated more effectively in the presence of uncertainty? RSQ2, RQ1
    b. What are the most effective communication coordination tools that you use? RSQ2, RQ1
    c. How can coordination strategies be applied to achieve agility in a large project? RSQ2, RQ1
    d. What success factors in coordination have you identified? RSQ2
    e. What coordination strategies are available to you and do the coordination methods help software development? RSQ2
4. What challenges are encountered when developing coordination between team members? RSQ3, RSQ2, RQ1
    a. What effect does coordination have on the team's schedule? RSQ2, RQ1
    b. Do coordination methods and structures provide a more satisfying place to work? RSQ2
5. Does coordination affect the performance of the team? RSQ2
    a. Does coordination effect the quality of outputs? RSQ2
    b. How does coordination assist decision-making? RSQ2
6. What is the relationship between coordination strategy and project coordination effectiveness in the context of work environment? RSQ3, RQ1
    a. How does the coordination process impact interaction between members of the project to reduce failures?
    b. What is the social capital value and person to person value?
    c. What challenges are encountered when developing coordination between team members? RSQ3, RQ1
7. Are coordination practices the same across different teams? RSQ3
    a. How is coordination carried out between groups that have different objectives RSQ3?
    b. How can we represent and analyze these coordination processes?
8. Does coordination influence team culture? RSQ3,
    a. What is the relationship between face-to-face communication and coordination methods in the team? RSQ3
    b. What is the best way to communicate between users on your team? RSQ3

9. Do you think coordination, collaboration, and cooperation have impact in human to human interactions? RSQ3, RQ1.

General Probing Questions:

1. Can you give me an example?
2. Tell me more.

Debrief:

Script

Thank you for helping me with this research study. I will contact you for a brief, no more than 30-minute meeting after I have transcribed our interview. I will have a summary of the interview with my interpretation of your experiences. I would like you to review the summary to confirm that I captured the essence of what you have shared with me or to identify where I did not understand so that I can correct the interpretation. Do you have any questions? Please contact me if you have any questions. Thank you!

Offer mental health resource list (EAP)

Appendix B: Coordination Observation Protocol

All observation and questions refer to the coordination methods

Introduction

Observations should observe the following:

- *The observer should have a shared understanding of the specific purpose.*
- *Where practicable efforts should be made to combine observations for different purposes and the most efficient use is made of opportunities for coordination observation.*
- *Observation should support and develop coordination knowledge–there should be minimal disruption to the project team activity.*
- *Observation arrangements should be planned to limit interruption to those involved in project activities.*
- *Observation should be objective, supportive and conducted with professionalism, integrity and courtesy.*
- *Successful observation requires preparation and appropriate consideration.*
- *As part of the partner corporation's overall arrangements for project activity observation the observer should seek to agree in advance the nature and timing of any feedback to be provided and with whom it is to be shared.*

Purposes of coordination observations

The purposes of observation can be grouped under the following areas (these are not necessarily exhaustive or exclusive).

1. *To observe the coordination methods of individual team members and/or groups to track coordination processes of individuals and groups across the program teams.*
2. *To identify team members' experiences in different settings.*
3. *Create awareness of coordination methods.*
4. *Part of continuing professional development and sharing effective coordination practices.*
5. *To identify and share knowledge on collaborative development.*
6. *Add to the research about coordination that supports transformation to scaled agile framework and the utilization of coordination to help that transformation.*
7. *To understand the methods and relationships impacted by coordination during a transformation to the scaled agile framework.*
8. *Increase understanding of how a large organization transforming to scaled agile framework uses coordination methods to provide software and systems engineers support to potentially improve the success of implementation of scaled agile framework?*

Does the Team Use:

1. Direct Contact: Written communication, modern electronic, mechanical devices, etc., can also be used. Direct face-to-face communication is the most effective way to convey ideas and information and to remove misunderstanding.
2. Group Meetings: Group meetings are said to be an effective means of achieving coordination. At the time of meeting, superior comes into personal contact with those connected with the actual problems. Such meetings encourage the people to integrate their efforts. Coordination can be achieved through regular meetings of superiors and subordinates.
3. Organizational Structure: Coordination can be achieved only when the authority and responsibility of each person are clearly defined.
4. Effective Communication: In achieving coordination, effective communication is vital. Communication greatly helps in coordination. Communication promotes deep understanding among members. It brings and maintains coordination to achieve the ultimate goals. Effective communication facilitates information and exchange of ideas to achieve the common purpose.
5. Committees: Various types of committees provide the means for synchronizing various efforts. Committees develop better understanding and morale among the members.
6. Staff Meetings: Staff meetings at regular intervals helps effective coordination, provides opportunities for open discussions and better exchange of ideas from different sections. This creates unity among the members which makes them jointly work for the organization.
7. Effective Leadership: Leaders instill a feeling of collectivism in the employees and directs them to work as a team. Leaders reconcile conflicting goals.
8. Informal Coordination: Adopt informal coordination through processes of social, unofficial interactions, relationship, and mutual changes--often more effective than formal means.
Ratings
0=Not Observed
1=Not Effective
2=Somewhat Effective
3=Effective
4=Very Effective
Overall, rating of the effectiveness of this coordination? 1 2 3 4 N/A

Observation Ledger Sheet is as follows:

Date & Team Activity		Open Meetings	Emails	One on One	A Receptive Atmosphere	Communication via Training	Everybody on same page - vocabulary	Visuals / Graphical coordination	Listen to Team Members	Body Language	Presentations	Encourage Feedback	Appreciative	Well defined goals	Organization structure	Organization structure	Meeting and conference	Group decision	Comments / Notes

Ratings Legend

0=Not Observed

1=Not Effective

2=Somewhat Effective

3=Effective

4=Very Effective

Overall, rating of the effectiveness of this coordination? 1 2 3 4 N/A

Appendix C: Historical Organization Data

Organization data one analysis

There is a pattern of using terms that are not measurable such as increased, better, less when explaining themes that went well. These themes however come at an early point in the introduction of this transformation. The terms less, more, better, and increased do not provide a reliable description, although there is a general sense from the persons providing these comments that there is a positive potential with this transformation. Some of the comments and inputs or responses are stated in terms that would make it important to know who made the comments, whether they were management or workers, and what position they had in the organization.

Requirements are always an issue in any major project. Indicating that requirements is a problem or theme that was not done so well would indicate that the team was unable to present clear requirements. In the responsibility of engineers has always been a historically missing or poorly defined fact.

Cost is mentioned whether it be cost or value these terms do need to be operationally defined in this context.

More training is needed is another undefined value. What is more, how much more, and when is it too much. Instead of defining a thing that was not well done as *more training needed* this needs to be defined as to what specific training, how much training, who gets that training, how long is that training, and what is expected from that training. A rapid onrush of training in the form of drinking from a fire hose did not provide the training

that would have prepared people for this transformation. In fact, once the transformation began training would have been more useful because people would have had some idea of what everything meant in the training.

Too many meetings were another item that was declared not to go well. They transformation required concurrent operations of the current method as well as the transformational method of operation. This meant all former meetings continued and new meetings were established. The result was that workers had additional meetings which eliminated time which they would have used to work on tasking. Not being prepared for this conflict it would be understandable that this comment would have been submitted as a theme not working well.

The term loss of authority is another instance of an undefined value. Loss can mean several things and the loss of authority assumes that someone knows what the value of that authority was and what it now is and can define the difference between the two. This is an instance where it would be good to know who provided this comment. If it was management then there are some ready explanations such as the transformational change from command-and-control to servant leader, which would leave the impression that they have lost authority. However, in the transformation teams are self-forming and self-defining and subsequently given authority to make greater decisions at the team level. This theme designed as a not so well theme, is open to interpretation and may not provide the information intended.

The inputs to these questions are not stratified and create more questions than answers. When asked how likely you are to recommend safe to another team the ratings from very

unlikely to very likely have a propensity to be stratified between levels within the organization.

The question about improvements as a result of retrospection assume the specific definition of retrospection in the transformation is understood by the respondent. A subsequent question in this survey asked about how often the respondent participates in the retrospection. Historical information shows that there is a small participation during PI planning. However overall participation is extremely low. It’s likely that a quantitative analysis of the response that is broken out by role of the respondent has some very skewed results. The primary participants appear to be the product manager business owner scrum master and architect. These are the key or core members of the agile release train and are expected to be at the retrospection. As a rule, recommendation to attend is less than participation. The lower participation from other respondents may infer a failure to achieve buy in. The histogram of retrospection active participation by role shows an, "us versus them" picture where those in a specific leading role are higher than the far right of the chart that includes team members. However, on the next slide most improvements come from the last two groups or team members. Another slide correlates likely to recommend responses and shows a large value of I never attend and a high value of it is great. Difficult to understand what that really means.

The question, what benefits have you seen as a result of your team or organization implementing scaled agile, provides a list of responses and number of responses in each category. The first question is whether they are answering for agile or for safe? One of the discrepant categories is submitted as none. In this category of none has four responses

which is the third-largest value of responses. The number one response is focus. It is interesting that visibility and coordination are the second largest number of responses, although it is not clear that the link between visibility and coordination exists to create added focus.

There is the question about what single change the program could make to improve organization performance. I think it would be very interesting if this exact same survey was provided today compared to very shortly after beginning transformation just how different it would be. The most significant responses are stop on non-software teams, buy-in, and eliminate redundancy. Beyond those the number of responses is one. Perhaps the repeated comment to reduce meeting time and the pop-up process are most striking. One at least continues a former comment and a continued pattern, and the pop-ups identified this early in the process provide the possibility that some teams understood what the transformation was trying to create. It is also interesting to note the discrepant response to eliminate safe.

The question, what single change could the program make to improve the organization's performance, has the number one response to not include teams that are not software. This is a clear bias against agile and safe by the hardware engineering teams. The next highest response was to create buy-in. The two of these responses are seen throughout this survey and should be considered significant.

Historical Organization Data One November 2017

Face-to-Face Went Well Themes

Excellent Value Stream Engineer	Increased communication
Increased Cross Project Visibility	Increased empowerment
Find Blockers Earlier	Better dashboard
Increased Awareness	Software team buy-in
Less Re-Tasking	PM/PO synch 6 item checklist
Increased Discipline	PM/PO roles done well
	We're doing something other companies are doing (i.e. Monsanto)

Face-to-Face Not So Well Themes

Requirements/System Engineering RAA "SPL" Issue not Resolved	More Training Needed Sprinting is more Stressful
Cost	Lack of Visibility while executing PI
Lack of Priority Arbiter	Rock Star Individual Contributors in Lead Roles
Lack of Acceptance of Change	Too Many Meetings
Inconsistent Participation by Managers	Priority Starving
	Product Managers Overtasked (This is Improving)
	Spread Charging
	Loss of Authority

Question	Response Values
What is your primary role?	All SAFe roles; and an "Other"
How likely are you to recommend SAFe to another team within Training and Professional Services (T&PS)?	1 = Very Unlikely 2 = Unlikely 3 = Neutral 4 = Likely 5 = Very Likely 6 = N/A
I actively participate in retrospection	1 = Never 2 = Seldom 3 = Regularly 4 = Often 5 = Always 6 = N/A
As a result of retrospection, improvement actions are defined and worked to completion	
Our program or value stream integrates and tests all components of customer solutions on a regular cadence.	
What benefits have you seen as a result of your team or organization implementing scaled agile?	Essay
What single change could the program make to improve the organization's performance?	
Please elaborate on why you would or would not recommend SAFe	

Survey Data and Analysis

Role	Count	Recommend	Actively Participate in Retro	Improvements are Completed	Integrate and Test Solutions Regularly
Team Member	14.0	2.5	2.0	1.8	1.9
Other	2.0	1.0	1.5	1.0	1.5
Program Manager	2.0	3.0	3.0	2.5	2.0
Product Owner	4.0	4.3	4.3	3.5	3.3
Epic Owner	1.0	3.0	5.0	2.0	3.0
Product Manager	4.0	4.0	4.8	3.5	2.8
Business Owner	2.0	4.0	5.0	4.0	3.5
Scrum Master	2.0	4.0	5.0	4.0	2.5
Architect	1.0	3.0	3.0	2.0	2.0
Solution Manager	4.0	2.3	2.5	2.3	1.8
Grand Total	**36.0**	**3.0**	**3.1**	**2.5**	**2.3**

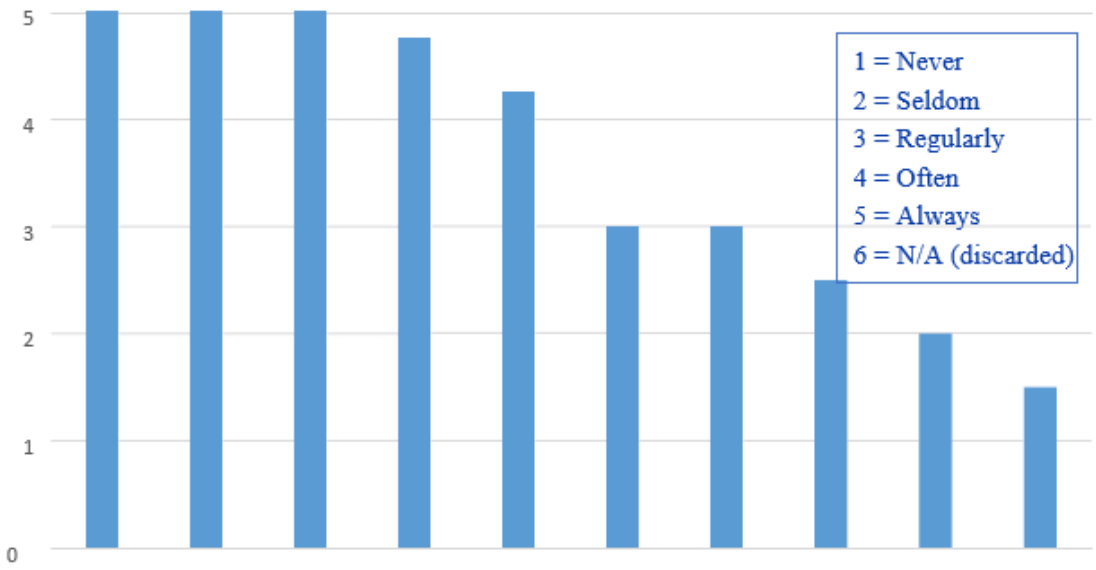
How likely are you to recommend SAFe to another team or organization?

Overall	Pgm A	Pgm B
Average	2.6	3.0
Median	2.0	3.0

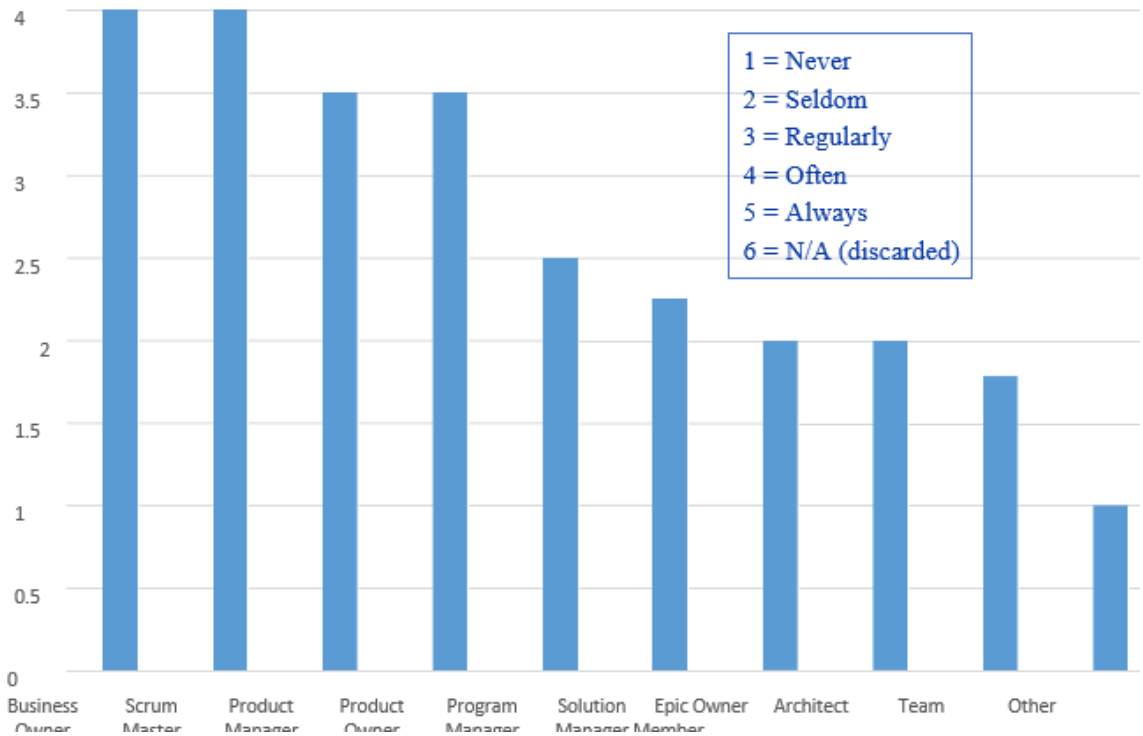
By Role	Pgm A	Pgm B
Team Member	2.0	2.5
Product Owners	2.8	4.3
Scrum Master	3.3	4.0
Architects	2.0	3.0
Product Manager	3.0	4.0

Survey Data and Analysis Retrospection Active Participation by Role

Business Owner	Scrum Master	Epic	Product Manage	Product Owner	Architect	Program Manager	Solution Manager	Team Member	Other

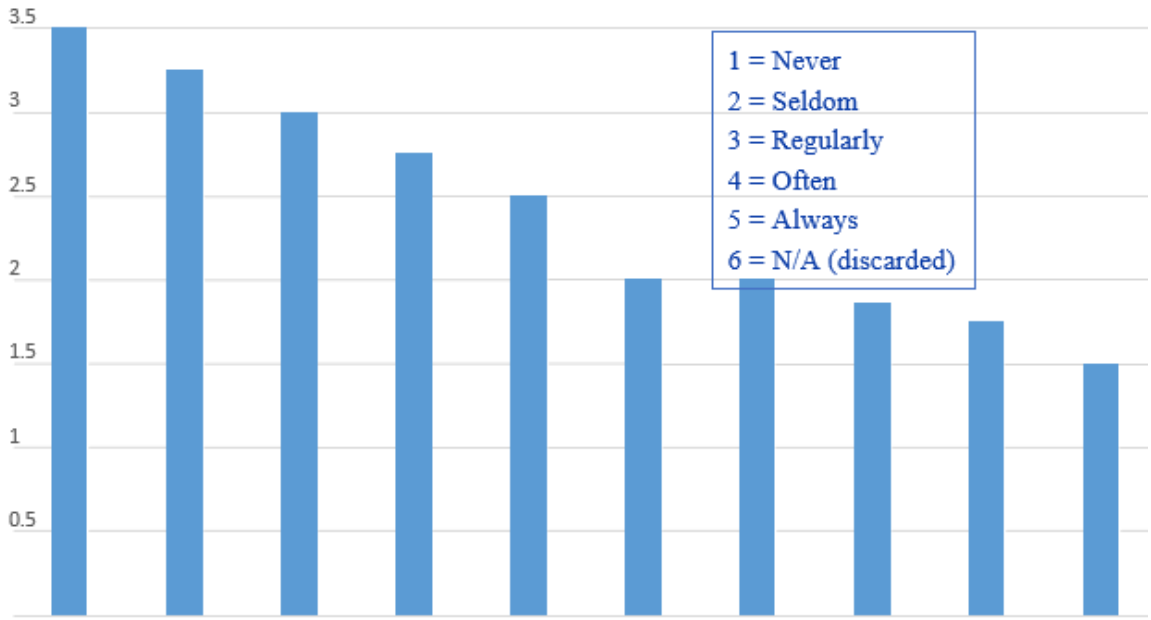


Survey Data and Analysis Improvement Actions by Role

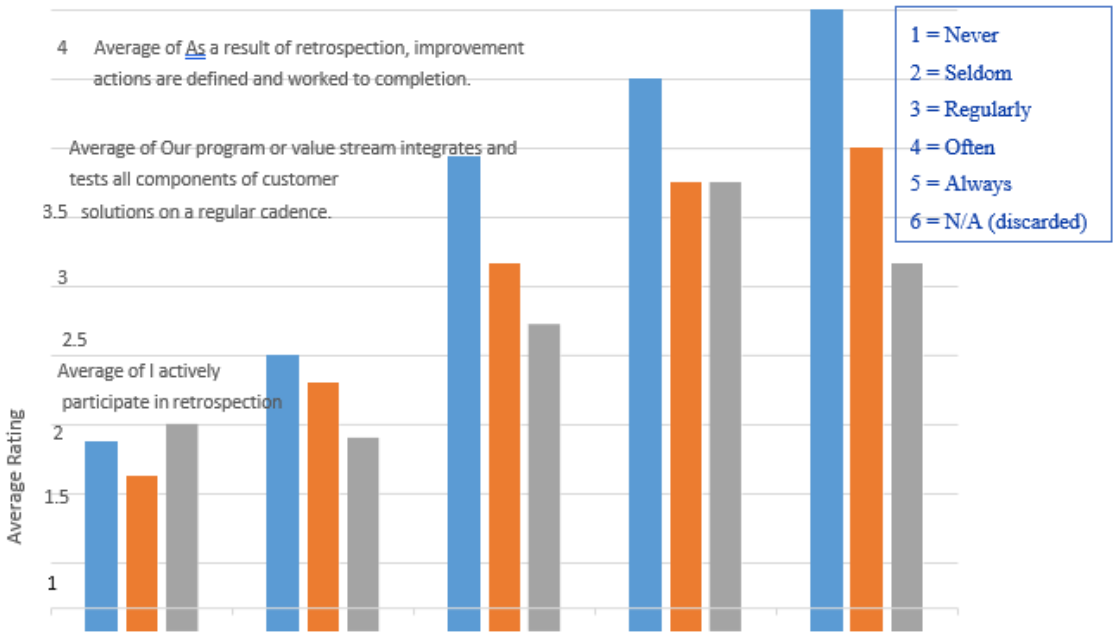


Survey Data and Analysis Integrates on Cadence by Role

Business Owner	Product Owner	Epic Owner	Product Manager	Scrum Master	Program Manager	Architect	Team Member	Solution Manager	Other



Survey Data and Analysis - Agile Practices Correlation with Likely to Recommend Responses



What benefits have you seen as a result of implementing scaled agile?

Category of Response	Number of Responses in Category
Focus	7
Visibility	5
Coordination	5
None	4
Planning	3
Communication	3
Management Communication	2
Expectations	1
Organizational Clarity	1
Metrics	1
Oversight	1

What single change could the program make to improve the organization's performance?

Category of Response	Number of Responses in Category
Stop on non SW Teams	5
Buy In	3
Eliminate Redundancy	3
Innovation	2
Reduce Meeting Time	2
Clear RAA	1
Don't plan sprint 5	1
Eliminate SAFe	1
Estimate SAFe	1
Popup Process	1
Reduce Management Disagreements	1
Reduce Role Churn	1
Remove Non-Agile Milestones	1
Solution Demo Improvements	1
Staffing	1
System Engineers on Train	1
VersionOne Speed/Interaction	1

Potential Improvements to Future Surveys

Fix the selection titles to be more clear on differentiation between picking a 3 and 4 (regularly and often)

Include a question on "do you participate in SAFe"

Consider adding organization and supply "do not wish to specify" as an option

Do this BEFORE starting, and do this annually on new adopting programs/teams

Questionnaire Why or Why Not Recommend

- I would recommend SAFe, because it forces us to plan our work in detail and allows us to see exactly what we work we have in front of us. It forces the program to decide on priorities helping us to plan work appropriately. Before we worked on the " squeakiest wheel" regardless of what was highest priority. Priorities seemed to change, and the program wasn't held accountable for changing them.
- Duplicate efforts in EVM.
- If a program already has a robust planning approach, I do not believe SAFE will provide enough benefit to offset the investment / costs required. If a program is struggling with its planning, it is an approach that way be worth the investment.
- Since SAFe was implemented, cost and schedule variance has increased. It has created too many layers between the project/program managers and the teams doing the job. We have increased roles and workload on the CAMs. SAFe keeps employees from working on actual tasks instead having to status in multiple programs, explain accomplishments. Certain people have become barriers to work being completed, instead of trying to help and get things accomplished.
- I'm a software developer and appreciate its similarity to agile. Plus, I love that I now get a break from constant interruptions and status requests.
- Just more busy work.
- I am a technician that has to react to issues from multiple teams that happen in real time that are critical to keep the testing of the device on schedule. There are SOME scheduled tasks but they few. If I were to follow scaled agile practices, we would not be able to meet the schedules.
- It does make it easier to see where the team is in tasks.
- Loose assets/individuals to made up/unrealistic positions that were already being handled by a position. I see this as a major cost increase when a team loses two people and then hire two new people to replace them. There is an increase of redundant work generated by SAFe. SAFe does not fit every team. Just like a glove does not fit every hand. You can force it, but it does not make it right. SAFe gave to much authority or power to lower levels that do not understand the holistic drive of a project. Team is not being allowed to self-organize.
- The maturity of a program should be factored into the decision to adopt SAFe. Long established programs may only gain very little or may incur additional expenses to operate under the SAFe architecture. Additionally, programs that are bound by rigid Government contracts do not lend themselves to being agile. Work packages are established in the early days of a project, well before a team has the chance to estimate them.
- While it has advantages for software development, SAFe has been forced upon the entire organization, which is inappropriate. It complicates processes and slows productivity greatly for non-software teams. I do like the information exchange and regular updates to the bigger picture during PI planning, but that can be done during a shorter meeting. Every 10 weeks, we lose one week of work, which equates to an automatic decrease of 10% in productivity.

- It has zero merit or application on a cross functional, cross organizational team such as what I am on.
- We are not seeing the productivity gains we thought would be made, although, the past PI did show some improvement because teams were able to pull tasks from below the waterline to execute. Metrics showing the magnitude of the productivity improvement, if any, are not well documented.
- The system appears promising, but so far it has only increased cost. Productivity gains have not emerged from the engineering ranks, while project management cost has increased.
- On program (who has good schedules, and strong teams that prioritize work prior to PI planning) SAFE works GREAT!!! On Pgm A, the lack of true schedules (where we are working behind and ahead at the same time because the schedule is so wrong), and without a clear list of priorities, it does not work so well. But that is not SAFe's fault.
- More disciplined approach to planning and executing work. Strives to keep interruptions to a minimum.
- I strongly recommend all programs/projects/teams adopt a collaborative agile model/framework; whether SAFe is the best framework for our business is yet to be determined.
- It can help define the tasks to be done and dependencies better than we have before. It acknowledges a team's load and tries to prevent overloading. It pushes the program (business unit) forward as a whole instead of an individual team moving forward while other teams stagnate
- I think it works very well for software, but not so much for other types of groups. It keeps team members insulated from program overhead, since we have scrum masters and POs to go to bat for us.
- Incurred costs are growing the program costs. I'm not seeing any change in performance to compensate for the cost increase. Software team seems to be the only portion of the team which is showing any positive feedback. Overall, program has been impacted negatively in performance due to staffing shortages and creating the additional SAFe roles has added additional impacts to that shortage. We need to scale implementation based on program duration from start of SAFe to completion date to ensure a possible return on investment.
- I'd be more inclined to recommend SAFe if the we could reduce some of the con's identified below. To be fair I don't think my train has seen as much benefit from SAFe because we were already doing large-scale agile to begin with. Pros: 1. Everyone is in VersionOne so we can easily associate work & see dependencies 2. Kanban's do make planning much easier 3. SAFe has identified resource issues much earlier than we would have known in the past Cons: 1. Seems like VLTS has done the bare minimum to check the SAFe boxes without stopping any old behaviors. E.g. we've added a bunch of meetings (Kanbans, Syncs, etc.) but still haven't removed most of the old project status meetings (stand-ups, weekly PTPs, etc.) so meeting overhead has gone up. ||2. Kanban only looks at the scope of capabilities and doesn't take into account whether the work is funded, within

contract scope, or has all pre- reqs met. Result = lots of stories get planned that are immediately blocked or get pushed out of the PI. Trains are being asked to plan a huge # of SP for a PI, get slammed when we say we can only commit to x% of that, only to find out once we enter the PI that a large number of stories are not ready. There is no check that a capability targeted for a PI is ready to be worked in that PI. 3. I'm not sure anyone has clear understanding of the level of detail capabilities should be written to. What I do know is that "Implement Radio Part 1" and "Implement Radio Part 2" are not adding value for anyone and that most solution managers aren't the right audience for solution demos. 4. Many stories have prereq on systems engineering work and we have nothing to tie those to b/c systems engineers (mostly solution managers) don't use stories. 5. Solution demos still aren't well defined and a step backwards from the Integrated Build Plan demos we used to have. 6. We've moved work scope into V1 but have no easy way to see when that work is due (dates in V1 are rarely valid). Still have about a dozen places where the projects keep their current/latest schedules. 7. SAFe is being blamed when EVM suffers. Sometimes that might be the case, but I'm not hearing project/solution managers flow up that their capabilities were the lowest priority or that the work was blocked for most of a PI.

- SAFe doesn't seem to solve any of the problems that are present. Yes, with PI planning teams were able to get together and actually come up with capability and a nominal ranking of importance but other than that nothing has really changed.
- The visibility provided to program management is invaluable - as long as the trains/teams are updating their statuses!
- It has upset the working rhythm and created duplication of effort in using multiple tracking systems (Version One in addition to previous legacy applications like Footprints). It has created churn and additional bureaucracy. It has complicated attending various daily meetings, additional weekly meetings, planning meetings, retrospective meetings, overlapping meetings, etc. More time is spent in meetings than doing anything. For some teams, some aspects of SAFe are not a good fit. It is demoralizing when some members barely participate, others try to live to the letter of the SAFe framework.
- Process is too heavy
- I believe the safe paradigm forces conversations to occur (re-prioritization, story closure criteria, etc) that were not explicitly required previously. I also value that it prevents overloading people.
- Other companies who implement SAFe use it primarily for software development and they measure in accomplishments, not a 10-week phase. We have also increased cost and taken people away from what their jobs to have weeklong PI planning sessions instead of working that week.
- From what I can tell SAFe does not care about schedule and being part of a group that deals with hardware we HAVE to deal with schedule while the SAFe system does not care about schedule commitments.

- Work originally done pre-SAFe are not getting done. We have moved SMEs from software roles (lead/SPL) to just SAFe roles which is unbelievable. If a SAFe role is 40 hrs/week, then this cannot be the right path moving forward.
- After 3 PI's it is still not clear that the benefits are manifesting, and future efforts aren't showing the expected benefits.
- It helps a large program have an operating rhythm and to consider all of the tasks it has before it.

Questionnaire Benefits

- The team has been able to focus and finish on their work. They know exactly what work they have coming up and they know what is expected of them.
- Duplicate efforts in EVM.
- Better coordination of plans across multiple projects and multiple EO teams / functions.
- A lack of staffing has been identified.
- Much more awareness of priorities. Easier to determine what to work to be working on. PO absorbs most day to day questions and operational questions. This allows me to focus on my work, not constant interruptions. The amount of email received is much lower, the number of meeting requests received dropped, and the same thing happened with phone calls. I couldn't be happier.
- no benefit whatsoever. VersionOne is a pain. Why does it show 'To Do Hours' as the total allocated all the time? Why doesn't that decrement as hours are worked against a task/story? DET is the same way. The titles don't make sense. What is the difference between Today and Effort?
- Absolutely none. I have seen communication issues not only on my team but on virtually all non-software orientated teams. I have talked to several team leads and they have all expressed that there is "funk" surrounding the Pgm B program because of SAFe. Program managers are afraid to say that it does not work so they say just do it and move on. With the manning draw down and people just saying I am leaving because Of SAFe (this includes ME) there are more people managing SAFe than doing the work. The few that have embraced SAFe are only doing so as a power grab and not to make it work.
- A reduction of pop up tasks. Better visibility of our tasks to other groups.
- Nome at the Team level. Organization level appears to have better oversight of upcoming projects.
- Establishing priorities for work at the program level, A regular planning cadence for team members to plan personal time to, more input from each team member are process improvement.
- Getting actual information from management.
- Zero benefit and a WHOLE LOT of contention, because all the different groups that require our skills want to control all our actions and limit our implementation of cross functionality

- The software team seems to like this approach. They are strong supporters of this business model. Other teams express frustration at the process.
- We have a clear picture of the work that is not going to be completed.
- On Pgm B: More communication within the group and with other groups, Earlier notification of requirements from other teams
- Minimal interruptions, exposing execution challenges that were not as transparent pre-SAFe, continuous improvement
- Have seen better long-term coordination & planning among program/projects/teams
- More cross training. More team communication. More realism in what can be accomplished.
- Better metrics, and we seem to get more accomplished.
- Scaled agile approach implementation increased customer engagement early in development process --set common expectations and clearer understanding of training device needs and capabilities.
- Less interruptions after each sprint with big planning meetings now done once every 10 weeks.
- Nothing has really changed other than we attempt to plan for 10 weeks and getting the various program managers ("Solution Manager") to communicate with each other.
- Our coordination between IPTs has improved as has the visibility of program priorities to the entire program. It is now obvious when one manager is trying to prioritize their own efforts at the expense of everyone else without prior coordination.
- Better organizational understanding of various participants; who is with what team, etc.
- Management visibility of work planned/accomplished.
- I believe the additional level of organization during planning has lead to a much smoother development phase. The reduction in context switching helps me focus and complete tasks faster.
- none
- We understand the work that's necessary from our various ARTs for a Program Increment. We now see management's priorities.
- There is more discussion about prioritization across the program.
- It is highlighting all the work that we have and forces the program to define priorities. SAFe is working well down at the team level because it helps us to organize our work and know what is truly a priority, but I still feel that it is not embraced by the programs as they have tried to stop doing SAFe.

Questionnaire Improvement Ideas

- Allowing the teams not to plan sprint 5 and use the sprint for improvements and catch up as the sprint is designed.
- Eliminate duplicate efforts or non-value adds.

- Work to make the process more efficient - look at opportunities to reduce meetings / meeting attendance; look at opportunities to reduce overhead roles and carefully consider what skills sets should or should not be moved to the overhead roles; require the teams to understand the pain points of the other disciplines and work to reduce / eliminate those issues - e.g. have them where the shoes of others to understand the issues. Tie the process to the business commitments that have been made and ensure everyone understands what team success looks like.
- Staff it properly. We continue to sign up for work and agree to deliver when we are not able to. As soon as we flip a baseline, we are already behind.
- Two things. One is more buy-in from managers. And the other, is some method of dealing with pop ups and how to charge the effort required to deal with them.
- review which teams actually need to be under the SAFE umbrella. It seems as though some of the software people really like it, but for several of the teams it is just another waste of time.
- Do away with SAFe for non-software related teams. Break out a separate charge line to show exactly what SAFe is costing Boeing and publicize it weekly.
- Tasks cannot be added that are not funded yet or on contract.
- I have only seen a team level retrospection, once. Do they really happen at other levels?? If so, maybe feedback during a PI on what issues are being addressed and what actions are being taken.
- Estimate contracts to support SAFe planning cycles and remove established milestones that prohibit agile planning.
- Implement it only on the Software development team. Every other team should be left out of the SAFe agile framework.
- Get rid of SAFe with regard to the Technicians.
- Make sure every program has a complete set of capabilities from contract award to delivery identified and scheduled in future PIs based on the CSPR work packages. Ensure charters clearly document RAA for each position.
- Reduce meeting span times
- On Pgm A: There are a ton of new folks. We need some kind of orientation of who is doing what SAFe related. And there are WAY TOO MANY MEETINGS. Impossible to get work done OR attend all the SAFe meetings - so we're going to get in trouble one way or the other.
- Supplier management issues create SERIOUS problems. (I know it's not SAFe, but it is the leading antagonist to performance and has been for some time)
- Need improved collaboration/decisions among the project managers & solution managers; the teams are still having to deal with miscommunications and disagreements between these roles.
- Having fully engaged train members from the top to the bottom of the organization.
- Figure out a better way for CM, IT, and the test team to implement AGILE/SAFE. The way it is now, it seems like trying to fit a square peg in a round hole and it frustrates people.

- Provide consistency across all development activities regardless of size. Process needs to be scaled but not ignored on smaller activities. Planning activities between EVM and SAFe as well as tool set activities seem to be redundant at numerous levels causing duplicate efforts. Demonstration of capabilities seems to have taken a step back since implementation of SAFe.
- Add systems engineers at the train level. Most solution managers (project engineers) do not have right technical background or the time to do proper requirement analysis & decomposition. We end up with poor requirements or the work just gets farmed out to the software trains who are already overloaded.
- Solution Demos are not value added as is. The few solution demos I've attended are not useful. Some of the solution managers who received the demos has no idea on what was being demoed due to vague capability scope. Only insight on capability was done by looking up backlogs which were under a feature single feature and asking for a demo on backlog by backlog basis. On top of that the only times found were from a single IPTs. This begs the question of how can only one IPTs backlogs cover an entire capability which effects 3-4 IPTs are impacted. Previously IBP (Integrated Build Plans) demos would occur with other IPTs and primarily done to test team with just System Engineer and/or PM present to review general functionality by reviewing OCs or general feature testing. Test team had more buy in because they actually cared how features worked and would have question/input on what they expected as well as possibly more test cases we didn't think of. Demo was more of a way to verify that functionality is going in right direction and no major surprises when HSI or Phase1 rolls around.
- Get full buy-in and active participation from all managers and remove those who refuse to buy-in and instead do nothing but obstruct progress.
- Figure out how to have less meeting time and make VersionOne interaction more efficient. People burn a lot of time in Version One either putting data in or trying to figure out how to get data out.
- I would like to see more emphasis on allocation of resources for innovation. To date innovation activities have been virtually non-existent due to trying to meet unrealistic schedules.
- get rid of SAFe
- Add more capabilities to our software teams (hire new folks or contractors). Decrease the time necessary to fulfill SAFe roles so folks can actually do the necessary work to make the program successful. If participating in a SAFe role is what we deem a necessity to make a program successful, then I believe we have it all wrong.
- There is too few visible metrics show progress and delay at the scrum level.
- Two things. (1) Allow for improvement/innovation. We currently don't plan anything for that. (2) Get the programs on the same page for SAFe. We've had so much churn with Solution Managers, System Engineers, etc. at the program level. Also, priorities change even after we've made a plan. This is what SAFe is supposed to prevent. So, more planning by the programs.

Appendix D: Interview Transcripts Combined Question Summaries

Research Subquestion 1

The first research subquestion was to address how coordination is achieved in a scaled agile framework environment. Each question on the interview protocol had corresponding research subquestions.

What new kinds of coordination structures you feel are desired?

P8 was glad to remove the silos and was, "Looking for avenues to get leaders from different teams to get together and talk about the problems and, talk about the dependencies that they were having versus you telling your manager that there is an issue, and then it kind of sits out there, they're busy, and sits there for two or three weeks, and by the time we figure out that this team had a problem, this other team."

Do you use different coordination methods in different situations?

P3brought up the concept of using more digital media for storyboards. plan." Pop up issues were a problem to all teams and depending on the specific context of each pop up, teams had to handle them though a various group of methods. All teams were sensitive that the pop ups would need to be run through the scrum masters and if more than one team was involved tin the pop up it could be further coordinated through PO and Program manager (PM0) before finding resolution.

What are the most effective communication coordination tools that you use?

The individuality of team personalities was evident in the responses to this question. and probably not very effective. The studies found in the Chapter 2 literature search had a strong indication that emails, computer, and internet would be the major media for communication and coordination. All teams had direct access to email and

internet but answered this question with a more specific response. P3 had a discrepant response and said, " digital interfaces actually segregate people more."

What success factors in coordination have you identified?

Meet contract and customer requirements and make sure that the input of the team is just have to learn to understand the people you regularly coordinate with." P5, that not getting surprises was a major success factor"

Does coordination influence the team's culture?

Every interview participant felt it had a very direct impact on culture. Coordination is not second nature to these teams. Everybody is very siloed and have their, what we call independent rice bowls. Several participants liked that that it could decouple the management decisions and let the teams make decisions

How does awareness play a role to provide appropriate coordination support for an effective collaboration?

Across all interviews, there was a feeling that awareness gave the teams some control over their environment and allowed them to self-manage the teams, " P4 felt the management chain did not provide the awareness that " concern that awareness was removed when new hires, especially those from outside the program were brought into the team.

Research Subquestion 2

The second research subquestion was to address how coordination increases the successful transformation to scaled agile framework. This group of questions attempted to focus in on coordination effects on proximity, uncertainty, software, schedule,

performance, quality, and decision making. Several discrepant responses began in this group of questions.

Does the proximity of the other team members affect the coordination?

The globalization of major projects has challenged that possibility and the evolution of digital tools has removed most of the previous obstacles to virtual team coordination. P5, P6, P7, and P8 felt it was a lot better to see someone and talk with them face to face. face to face. P12 felt proximity is negated if the culture is not adapted to good coordination.

What challenges in coordination are linked to large-scale transformations?

The responses from this question covered the five basic themes evolving from the analyses. The responses answered questions about the patterns of meanings, implied participant patterns, what issues participants identified, the implications for participants and society, and relative implications against the current academic literature. More important than the responses that concurred with the current literature, were those responses that did not perfectly align with the current literature. P2 replied on the challenge of " Having each department or division in their own little silos and trying to break those walls down." This comment fits into the cross-boundary theme, while the P3 comments fit into an unanticipated continuing theme of leadership and management. P3 responded " There seems to be confusion with program management and all those entities have to somehow be involved in the product development lifecycle." P4 and P5 program, that engineers are reluctant to change." P6 talked about cooperation and involvement of the team, about inclusiveness, and identifying team member value. This fits into the

cognitive diversity theme and is supportive of the greater value of cognitive diversity as a solution to several transformation obstacles. " It's a totally different mindset for individuals making the transition from waterfall to agile" and added that buy-in was not the same as agreeing to follow the directions. P11 and P9found a challenge with too many different opinions and lack of synergy across boundaries. P12 also felt there were too many competing priorities. P12 felt the issue with so many ambiguities were the ineffective leadership. This represented a conflict of wanting leadership but being autonomous.

How can project development be coordinated more effectively in the presence of uncertainty?

The interview participants have been working for years using the waterfall process. They understand how it works and what doesn't work. Now they are told there is this whole new way of doing business and they're going to reorganize the entire organization. It is going to be completely restructured, given new names, position's names are going to change, and going to have new metrics, and in the middle of it, they must continue getting work out the door, while transforming to this whole new organizational structure, and culture. Everything changes and they are sitting there and don't know next week, next month, what they are going to be doing, how they are going to be reorganizing again, what new names are going to be given to the same things they have been doing for years, and if they are going to be coming to work in a month, two months? That is a lot of uncertainty for somebody to be working under, and try to get something out the door, and make this big change, all at the same time. P1, P2, P3 and P4

responded with methods to improve certainty within the project. All these comments are supported in the literature review. "P8 responded to the rapidly changing environment and the conflict to get things completed and to attend meeting about new changes. P10 added to the impact of the changes and delayed clarity of the changes and said it, "may cause people to get up and walk out the door, because they feel as though they're going to be forced to do overtime and fail." P11 submitted a suggestion that, " the biggest driver to eliminate some of this uncertainty, is to stop signing up for unrealistic schedules, stop staffing up beyond the bounds of sanity and assuming that someone can walk in off the street and not require someone else's time to spin them up."

What are the most effective communication coordination tools that you use?

Most answers provided responses such as Instant Messenger, WEBEX, email, and face to face discussion. PI planning meetings were consistently touted as a best practice and the personal discussions were valued. P3 added that, "Part of building the trust and helping people understand in the transition is having that one-on-one conversation and being open and honest and helping them understand." The idea that a clear agenda made the coordination effective continued to be a common practice from several teams."

How can coordination strategies be applied to achieve agility in a large project?

"You can decentralize decisions and allow individual teams to make decisions that affect their team." P3 felt, "most of that information doesn’t get flowed down" and P5, P6, and P7 felt finding a common baseline and sticking to it was a good strategy. P9 talked about the culture of the team and P10 identified the personalities of the leadership roles as factors affecting strategies.

What success factors in coordination have you identified?

The recurring theme of cognitive diversity was evident throughout the responses to this question. P1 and P5 provided," Knowing what teams have what knowledge" and being able to identify who had what knowledge base is very helpful. A success is, "not having to explain to the managers, why we're not getting our stuff done."

What coordination strategies are available to you and do the coordination methods help software development?

Often teams would form silos that used their unique tool. Other comments provided that the attempt to merge into a small group of common tools was a larger challenge that could be addressed effectively. P3 stated that, "Requirements are thrown over the wall to the next team. And there's no real clear conversation." The coordination used to help software development helped to flow risks up the process and gave teams opportunity to address blockers and move forward.

What challenges are encountered when developing coordination between team members?

The key responses to this question included, inexperience, personalities, age, new team members, and conflict with velocity. P12 summarized these challenges as, "The human element, conflicting personalities that, for whatever reason, cause friction." P11 added some detail on a specific personality type that was a challenge. Some personality types do not like to talk or interact with others. In situations where these are the key subject matter experts (SME) that lack of coordination can be critical. Personality clashes

was also a potentially serious issue with some teams. In the instances where personality clashes affected performance it was necessary to turn the matter over to management.

What effect does coordination have on the team schedule?

Every project has its own schedule and that schedule must coordinate with every other team schedule that has any dependencies. Some teams felt that t was easier to work their schedule as a team and not use email or other digital media. P5 indicated that some people are annoyed by the meetings required for schedule coordination and may attempt to fall back into a waterfall method. P8 indicated that, " All interview participants agreed that coordination directly impacted the schedule.

Do coordination methods and structures provide a more satisfying place to work?

Most interview responses declared that structure and coordination provided the means to cross communicate with other teams. P3 added that, "It really helps if you have a diverse team." P3 unknowingly made a case for cognitive diversity and said, "It removes the underlying biases that people carry with them into the company. But as a leader you must force the conversation. You can’t let somebody sit in the back of the room and say nothing." The comment about letting people sit in the back of the room and say nothing is like previous interview comments about personalities that do not like to talk with other team members. P8 added that having that structure and knowing how to get things removed and blockers out of the way was helping to make the work environment more satisfying. Knowing that you have that support system you can rely on gives the team members a sense of security and belonging.

Does coordination affect the performance of the team?

Every interview participant agreed that the answer to this question was yes. They added some supporting comments that make the overall response to this question more useful to implementing a positive performance. P1 indicated that, "it allows everybody to see what other people are doing and reacts to the whole instead of their own separate part. And will lead to more value." P2 added that it is especially true when interacting with other teams. P3."

Does coordination affect the quality of the outputs?

All respondents agreed that quality was affected by coordination. The primary response was that it was a positive link between good coordination and good quality. Some examples of the cause and effect relationship of coordination and quality were provided. P3 felt people could ask questions without fear of being embarrassed. They were not afraid of the coordinated feedback. P4 P12 added a comment that, "Ineffective coordination results and potentially results in a delivered product that was rushed or has defects, that could have easily been prevented." Avoiding those defects that could be prevented is a very positive consequence of good coordination.

How does coordination assist decision-making?

Coordination was seen to be a prime tool for good decision making. The primary example of a good decision-making environment was the PI planning. The consensus was that there were a diverse group of participants at that planning session and "it allows you to make decisions with more perspective and make more system-based decisions and less subsystem-individual-based decisions." P1 felt the diverse group encouraged shy people to speak up without fear of embarrassment. P5 agreed that the PI planning gave the

opportunity to, "take all of their thoughts, and somebody may have something that you didn't think of that is a better idea than what you are initially planning to do and it kind of gives you a third point of view."

Research Subquestion 3

The third research sub question was to address how the coordination process impacts interaction between members of the project to reduce failures. This group of questions attempted to focus in on coordination strategy and project coordination, impact the interaction between members of the project to reduce failure, value of social capital, challenges coordinating between team members, common practices, competing objectives, analysis, face to face coordination, team member coordination, and human to human interactions. Each question on the interview protocol had corresponding research subquestions. Several discrepant responses were noted in this group of questions.

What is the relationship between coordination strategy and project coordination effectiveness in the context of the work environment?

The responses to this question indicated a lack of understanding of what strategy means in relation to coordination. P1 used the answer to discuss the empowerment of the teams. P1 said, "the team members are not necessarily empowered, so it does not necessarily provide a good metric of how SAFe works for us because there is a key point that we are missing. Empowerment is a key concept for effective scaled agile framework transformation. The coordination strategy should provide information and allow autonomy, so that team members take more ownership and work harder toward results

and that leads to more effective results. trust, which is important to the context of the work environment.

How does the coordination process impact the interaction between members of the project to reduce failures?

Coordination within the team was demonstrated to build trust and to increase the flow of knowledge. P5 responded, "Being able to coordinate with somebody who has the knowledge base that you're looking for in your project helps to keep you on track and ensure that you're not steering off, so that you're not wasting time doing something that you shouldn't be doing or don't need to do." This response answer both sides of the impact and indicated that failure reduction can be measured by the avoidance of non-value-added work and the ability to perform the activity correctly the first time.

What is the social capital value person-to-person value?

Social capital refers to those factors of an effectively functioning social group. Social capital includes interpersonal relationships, a shared sense of identity, share understanding, common values, trust, cooperation, and reciprocity of the members of the group. Social capital may be used to explain the performance of diverse groups. This concept was not familiar to many interviewed and the various definitions of social capital had to be explained. Subsequently, the interview participants were able to provide several various responses, and some felt comfortable enough to use the term in subsequent responses to other questions. P5 also warned that, "One bad egg or one person who is very reluctant to do anything outside what they're used to and everything just takes a nose dive, because then all of a sudden were very cautious of what we talk about out loud or

what we say, because we don't want any conflict, or what we say gets a lot of pushback from this negative individual and it doesn't help the situation." " P8 made the statement, "you'll notice there is there's a loyalty and some people are more likely to, because they feel like they've been invested in socially, and that you know if something does arise in their life, that they can still return to work and that work is like is a safe place, instead of being another burden to add on top of more fuel to the fire." The implications of such an environment are significant and provide great value to any team. P9 added that social capital can reduce conflict within the team.

What challenges are encountered when developing coordination between the team members?

P1 identified the older knowledge presence or the way things used to be. Younger members of the team were suspected of not familiar with anything other than books and the mid-level person that worked with both groups. P2 identified that the project manager had to work with disparate teams and be able to communicate clearly with all. Communication between these two teams could be a challenge. P5 introduced the challenge if, "people are stuck in their ways and aren't open to collaborating."

Are coordination practices the same across different teams?

Only one participant felt the coordination practices were the same across teams. The overall corporate goal of delivering first time quality product on time, was not considered t be the common objective. P3 thought, "Because of the different personality and different level of understanding, you can't have a cookie cutter for people." It appears to represent a gap in the understand of SAFe and how autonomous teams operate within

that greater organization. When a team is not working dependencies in coordination with the greater schedule plan, it causes conflict and blocks production completion.

How is coordination carried out between groups that have different objectives?

Study findings identified the necessity to define a strategy regarding the objectives and not lose the vision of the organization and the constraints of the organization interaction (Guzman et al., 2010). Teams develop their own culture and goals and transformation to scaled agile framework requires a significant restructuring of the organizational objectives. P3 stated that the higher-level objectives were discussed at a higher-level but did not identify the intersection of the higher-level discussion and team level objectives. P4 did say their objectives were driven by priorities, which were identified at the higher level. P5 responded that, "we pretty much work on our own, but the coordination between teams just helps to identify anything that's dependent on anything else." This helps to explain how the team sets team objectives that intersect with organizational and program objectives. The difficulty in completing this coordination rests in the need to coordinate ten team's objectives into the organization objective."

How can we represent and analyze these coordination processes?

This question was intended to obtain some metrics and identification of factors being collected to obtain those metrics. I do not think that information was received as expected, but each participant responded within their own interpretation of the question. It was helpful that each respondent understood the items they would look at to determine how they were doing. A few interview participants indicated they use some mapping product to track progress and gain knowledge of how the team was doing against the

plan. One used a hierarchical construct and others used value stream maps. The value stream maps were flow charts, because takt times and queue times were not identified. Teams tended to be focused on tactical objectives.

What is the relationship between face-to-face communication and other coordination methods in the team?

The interview participants had answered this question in previous responses and this opportunity only added minor comments. It was clear that all respondents preferred face to face communications. P1 and P2 found face to face more formal and probably the best coordination method, but the geographically separated units had to find alternative communication methods.

What is the best way to communicate between users on your team?

There did not appear to be any difference between general communication and within team communication. Some teams were geographically separated and would require some method other than face to face. Other participants said that it would depend on the size of the group receiving the message and the context of what was being requested. There was still a preference for face to face, but digital methods were more acceptable in many instances.

Do you think coordination, collaboration, and cooperation have impact in human to human interactions?

This question was based on Deming's (2018) comment that humans are part of the system. Too often teams are overwhelmed with time constraints and excess workloads that consideration of humans as part of the system is ignored. The conceptual framework

of this study was centered on von Bertalanffy's general system theory and Malone's coordination theory. Coordination processes impact on humans, organizational structure, evolving methodologies, and, information transformation and adaptation (von Bertalanffy, 1969). Constructs are increasingly abstract with the increase of empirical knowledge, and human forms of cognition adapted to dealing with a specific environment (von Bertalanffy, 1967).

Malone (1988) wrote that information use would change people working together, and it is essential to imagine new possibilities and to look for analogies of how coordination occurs in different kinds of systems. The effects on humans in these organizations are more complicated than project failure. Project failure affects employee security in the changing work environment and concern over continued career movement. Employees are faced with a chaotic situation of systemic change and confusion when an organization implements a transformation to scaled agile framework. There is a cognitive presence across all aspects of organizational transformation and that human functionality is a significant portion of any organizational system affected during the transformation to scale agile (Crowston & Malone, 1998; Cockburn & Highsmith, 2001; Shih, Shaw, Fu, & Cheng, 2013). The success of those systems involves the understanding and structuring of an organization to support the human psychosocial knowledge and helping those needs can reduce resistance to can create a more cohesive work environment that has greater flexibility and adaptability (Gordon et al., 2013; Shih et al., 2013). Transformation to scaled agile framework environments requires organizational changes that impact the psychosocial factors affecting the human systems in the organization. Interview

participants agreed that the communications between team members increase trust, improved understanding, transferred knowledge, and support individual feelings of value within the organization. P5 added that the constant change presented high probability of losing knowledge that was vital to successful project completion.

What was not asked and Leadership comments

The following responses were received from interview participants:

- There might be some case study of a non-software team success that we could use.
- If the company wants this to work properly, then management has to take a big interest in it and get out of their culture and their methods for saying just throwing more money or more people at it to fix it and truly live by the safe agile principles.
- The schedule is unworkable, yet they're trying to go by the schedule so we can get paid, and you're burning people out--big time. So, that is the one example of culture that they need to change.
- SAFe is a good methodology, if everybody participates in it like they should. And if everybody understands what the goal is.
- Digging in as a leader and understanding your team.
- Really felt our management did not care about SAFe and it was being pushed upon them.
- We need to find a common baseline. It is not a want; it is something that must happen to keep everyone on the same page. Not having people on the same page

causes conflict.

- We didn't talk much about transition when we went from waterfall to safe--what changed? A lot changed from waterfall to safe! And, really for systems engineering.
- We talk about career growth, with emphasis on management and not about SMEs. It seems the big thing right now is retention and how to get people that are, fours and fives with great knowledge and tribal knowledge, to stay, and train some of the newer kids.
- It's just as effective to talk about where things are failing instead of only talking about where things are positive. I think more thought needs to be given to how to change that mindset from everything needs to be positive, because we need to know all.
- I don't know how it can be done, but getting a team to buy in, is worth more than anything-–rather than saying we're gonna do it and just move out.
- I think there ought to be some role for managers other than just staffing, but it's unclear what SAFe expects that to be. Senior management perform live demonstrations of using the tools and executing the processes, that they have, unknowingly, required every teammate to accomplish daily. Specifically, to use version one, on an hour for hour basis, documenting every task and updating the hours of the toward specific tasks, and providing a demonstration. Those two actions would be the silver bullet to, obtain buy-in from the more seasoned individuals highly resistant to change.

Appendix E: Coding and Theme Examples

Coding and Theme Examples

Participant Alias	Interview Excerpt	Category	Theme
P1	" We seem to have a tool for everything that we want to do. And if there is a challenge, it's not that the tool doesn't work but it's that there is so much to learn that it takes a while to be really be proficient with all the tools that you need to be proficient with."	Achieving large-scale coordination.	Overcoming transformation challenges.
P2	" It used to be separated and things used to get done without knowledge of the people upstairs versus the people downstairs."	1) Transformational organization structure; 2) Environmental context	centralized-decentralized structure transformation
P3	" The lack of awareness is used as the excuse why something doesn't work versus really searching stuff out to become aware of it and so the concept of our cost is varied."	Awareness and effective collaboration	Effective – efficient performance
P4	"We need to continue changes so we can be more "SAFe like" otherwise people aren't going to take it seriously "	1) Transforming organization culture; 2) Uncertainty	1) Centralize-Decentralize structure transformation; 2) Transformational Leadership; 2) blocking artifacts.
P4	" Trying to get into that framework where we know that our work is dependent on other people and vice versa is a big thing for us because it helps to minimize the timeline."	1) Awareness and effective collaboration.; 2) Transforming organization culture.	1) Cross-Boundary coordination; 2); 2) Knowledge transfer
P5	" I think getting people to change what they used to, to jump into something that's not familiar. I've definitely seen, on my program, that engineers are reluctant to change."	1) Psychological safety; 2) Uncertainty; 3) Human in the Loop	1)Transformational Leadership; 2) Cognitive diversity.
P6	" If we don't identify what people are doing, there could be overlap, everybody can be working the same issue, and the full project never completes."	1) Value and performance; 2) Environmental context; 3) Human in the loop.	1) Knowledge transfer; 2) Quality; 3) Blocking artifacts.
P7	" Staying coordinating keeping the schedule in everyone's mind is so key"	1) Value and performance; 2) Transformational organization structure	1) Cross boundary coordination; 2) Effective – efficient performance; 3) overcoming transformation

			challenges.; 4) Aligning capacity.
P8	" If you need to show management what we're doing, or that there are things that are blocking your success, because you have all these pop ups, you know, let's document this together and find a way that it's not too much of a burden for you, but in a way that tells your story."	1) Personalities and perspectives; 2) Humans as part of the system; 3) Environmental context; 4) Social capital.	1) Overcoming transformation challenges; 2) Centralize – decentralize structure transformation; 3) Effective – efficient performance; 3) Cross boundary coordination.
P9	" It seems like the more coordinated teams, are a tighter knit team, have more of a friendly relationship, a more cordial relationship with all of the members."	1) Social capital; 2) Personalities and perspectives; 3) Competing objectives; 4) Psychological safety.	1) Blocking artifacts; 2) Knowledge transfer; 3) Cognitive diversity.
P4	" Nothing against the younger generation, but it's just technology, they don't want to do anything in person anymore."	1) Social capital; 2) Personalities and perspectives; 3) Psychological safety.	1) Transformational Leadership; 2) Knowledge transfer; 3) Cognitive diversity.
P3	"If they're around the same age, have the same interests then they take more time. If it's the younger group of folks, they don't want to deal with them too much unless they have the same underlying interest that they have and then they'll take the opportunity to spend more time with them	1) Social capital; 2) Personalities and perspectives; 3) Psychological safety.	1) Transformational Leadership; 2) Knowledge transfer; 3) Cognitive diversity.
P1	"I think part of that is just the nature of younger team members to not have as much say."	1) Social capital; 2) Personalities and perspectives; 3) Psychological safety.	1) Transformational Leadership; 2) Knowledge transfer; 3) Cognitive diversity.
P6	" You have to know who you bring you to your team to see how they're going to fit in with the group."	1) Social capital; 2) Personalities and perspectives; 3) Psychological safety.	1) Transformational Leadership; 2) Knowledge transfer; 3) Cognitive diversity.
P3	"If they're around the same age, have the same interests then they take more time. If it's the younger group of folks, they don't want to deal with them too much unless they have the same underlying interest that they have and then they'll take the opportunity to spend more time with them"	1) Social capital; 2) Personalities and perspectives; 3) Psychological safety.	1) Transformational Leadership; 2) Knowledge transfer; 3) Cognitive diversity.
P10	"I have another team that is very tightknit like that, socializing after hours, but having a special night out, but again, I think it's a case-by-case, because I know another thing that doesn't do that much at all. So, it's, it's, it varies. If there, and I can't	1) Transforming organization culture; 2) Personalities and perspectives; 3) Humans as part of the system; 4) Social capital.	1) Cognitive diversity; 2) Transformational leadership; 3) Knowledge transfer.

	explain, because one team, I'm gonna say has the more senior members in it, compared to some of the other team members were younger than my son",		
P11	" One team is almost composed of classmates from the same university, which helps it along, but they tend to have parties at each other's place. They tend to go out to lunch. They also just tend to work together in general better."	1) Transforming organization culture; 2) Personalities and perspectives; 3) Humans as part of the system; 4) Social capital.	1) Cognitive diversity; 2) Transformational leadership; 3) Knowledge transfer.
P12	"Without awareness upstream and downstream, dependencies cannot be identified."	1) Awareness and effective collaboration; 2) Uncertainty; 3) Competing objectives; 4) Achieving large-scale coordination.	1) Cross boundary coordination; 2) Effective – efficient performance; 3) Centralize-decentralize structure transformation.