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The Perceived Effectiveness of the Scaled Agile Framework® In Software Development Organizations

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THE PERCEIVED EFFECTIVENESS OF THE SCALED AGILE FRAMEWORK® IN SOFTWARE DEVELOPMENT ORGANIZATIONS

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ABSTRACT

Software development projects experience very high failure rates. Due to the high cost of project failure, coupled with studies that found failure rates are closely tied to the software development method used, the purpose of this mixed methods exploratory case study was to examine the extent of perceived effectiveness of the Scaled Agile Framework (SAFe®) in software development organizations using Complex Adaptive Systems as a lens to guide the study. This research focused on the extent of perceived effectiveness of the Scaled Agile Framework® on organizational outcomes, team management, stakeholder and customer management, management of emerging requirements and overall organizational agility.

Three organizations took participated from Retail, Government and Logistics industries. Each organization transitioned from the Waterfall method to SAFe®. In all three cases, the participants reported the transition to SAFe® helped improve strategic alignment, facilitate business / IT coordination, increase speed of delivery, improve software quality, and reduce rework by applying Lean-Agile principles resulting in lower overall costs and reduced risk.

Principle challenges included the need for change management and training to help assimilate the new structure, roles and responsibilities. Another significant challenge cited was the transition from project management measures (e.g., cost, scope, schedule, earned value) to SAFe® measures of throughput (i.e., working software) and value (i.e., prioritized features based on business value). Interactions with “non-SAFe®” organizations were cited as a concern for dependencies on other teams that could result in schedule and priority misalignment.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Information technology is an integral part of business today. Agriculture, defense, education, government, manufacturing, medicine, and services organizations all rely upon information systems to meet their strategic goals (Baskerville & Myers, 2002). At the heart of information systems is the software that end-users and other systems interact with to perform specific business functions (e.g., Accounting, Enterprise Resource Planning, Customer Relationship Management). While software is so important for many facets of business, despite many attempts at improving processes (e.g., Waterfall, Scrum, Kanban), software development remains an imperfect process (Cao, 2006).

A recent survey by The Standish Group (2015) of over 50,000 global projects found that only 29% of software development projects succeeded, while 71% failed to meet the initial expectations. This failure rate applies to software developed for commercial software products (e.g., Human Capital Management, Sales and Marketing) and software developed internally for an organization to meet its unique needs with customized solutions. Software development failure comes with high financial and opportunity costs. The Project Management Institute (PMI, 2016) conducted a cross industry global survey of 2,428 project management practitioner and estimated that organizations will waste $122M for every $1B invested in IT projects.

Because of the significant impact of software development project failure to organizational costs, many studies (Amjad et al., 2018; Anthopoulos et al., 2016; Cecez-Kecmanovic et al., 2014; Gulla, 2012; Hamidi, 2014; Hughes et al., 2017; Krigsman, 2009; Stoica & Brouse, 2013; Wiklund & Pucciarelli, 2009) have been conducted to determine the root causes and possible solutions for software development project failure. Ahimbisibwe et al. (2015) found 37 primary reasons for software development project failure in their review of 148 articles. Chow and Cao (2008) determined which of several failure reasons were statistically significant. Chow and Cao's study provided a taxonomy that organizes failure reasons into organizational, process, people, and technical dimensions.

Recent large-scale independent studies from The Disciplined Agile Consortium (Ambler, 2018), The Standish Group (Clancy, 2014), PMI (2016), and VersionOne (2018) yielded similar findings to one another that included the top three reasons for IT project failure: lack of executive sponsorship, inability to respond to changing business priorities, and inadequate management support. Studies that focused specifically on software development project failure share these top concerns (Ahimbisibwe et al., 2015; Charette, 2005; El Emam & Koru, 2008; Chiyangwa & Mkandla, 2017). The Standish Group (Wojewoda & Hastie, 2015) also provided a percentage attribution of each failure reason. Using the research, the taxonomy provided by Chow and Cao (2008), and the failure attribution rates published by the Standish Group in 2015 (Wojewoda & Hastie, 2015), the root causes of software development project failures can be categorized as: organizational factors (64%), process factors (21%), people factors (15%) and technical factors (less than 1%).

The literature suggests failure rates of software development projects are closely tied to the software development method used (Ambler, 2018; Cao, 2006; Gemino et al., 2007; Joslin &

Müller, 2015; Nasir & Sahibuddin, 2011; Pace, 2017; The Standish Group, 2015; Wells, 2012; Wright, 2013). As such, methodologists, practitioners, and academics have created new software development methods over the years to overcome the reasons why software projects fail (Banerjee, 2012). Waterfall and Agile methods are two such well-established methods for managing software development projects. Although Waterfall and Agile software development methods recommend an organizational structure, software development life cycle process, and roles and responsibilities, each has had its own strengths and weaknesses.

The Waterfall method, the earliest software development method, is attributed to the work of Herbert Benington in 1956 and is widely used today in government projects and many major companies (Munassar & Govardhan, 2010). Waterfall leverages a hierarchical organization structure where a portion of the process (Conception, Initiation, Analysis, Design, Construction, Testing, and Maintenance, [Royce, 1970]) is performed by one part of the organization and when finished, the work passes to the next team (Balaji & Murugaiyan, 2012). This method was introduced because it offers more control than earlier ad hoc and trial and error methods, and comprehensive documentation is available for the next process step. However, as the adoption of this method grew, the inflexibility to adapt to change emerged as a major weakness. A central problem is that the scope of work is determined at the onset of the program; and those fixed requirements are cascaded throughout the life cycle (Ji & Sedano, 2011). Creating a condition that by the time the software product is delivered, the business needs have changed. Today, only 11% of software development projects using a Waterfall method are considered successful while, 60% are challenged (failure to meet initial success attributes of: on time, budget, target, goal, value, and satisfaction) and 29% fail outright (The Standish Group, 2015). Collaborative software development methods, collectively termed “Agile methods”,

evolved after different incremental and iterative approaches aimed at increasing project success rates were tried in the late 1980s. Agile methods were introduced in the late 1990s (Ruparelia, 2010) and are used today by technology, financial services, professional services, insurance, government, healthcare and pharmaceutical, industrial/manufacturing, telecommunications, energy, education, retail, transportation, media/entertainment and non-profit industries (CollabNet, 2019). Agile methods, as the name implies, were introduced to increase organizational agility by supporting the need to respond quickly to change and minimizing rework found in traditional methods (Barlow et al., 2011). Using Agile methods, the full software development lifecycle is performed by a small collaborative work team, generally smaller than 15 people (Ambler, 2010). Teams can respond quickly to change because they develop software incrementally, in short time-boxed development cycles or "sprints", and they focus on developing the highest priority features in one- to six-week delivery increments (Schwaber & Beedle, 2002). Agile projects, while more successful than Waterfall projects, still have high failure rates. Only 39% of Agile projects are considered successful, while 52% are challenged and 9% fail outright (The Standish Group, 2015). Three criteria must be met for the project to be deemed successful including: delivered on schedule, on budget and providing the scope determined at the onset of the project (Ambler, 2018; El Emam & Koru, 2008; Gemino et al., 2007; Sauer et al., 2007; PMI, 2016; The Standish Group, 2015). Projects that do not fully meet all three criteria are considered challenged and those that do not deliver a final product are categorized as failures (Ambler, 2018; El Emam & Koru, 2008; Gemino et al., 2007; Sauer et al., 2007; PMI, 2016; The Standish Group, 2015). Moreover, although Agile harnesses the efforts of small, nimble teams, Chiyangwa and Mankandla (2017) suggested Agile software development projects are challenged (and some fail) primarily because the method focuses only on small

teams and largely ignores the overall organization in which the teams operate making it difficult to deliver on time.

A group of "Large-Scale Agile" software development methods is starting to emerge. Public (Mergel, 2016; Moulton, et al., 2017), private (Denning, 2018; Laanti, 2014) and non-profit (Sandberg, 2018) organizations are interested in not only expanding upon the success of Agile methods at the team level but are also interested in introducing new governance and organizational oversight models (Alqudah & Razali, 2016). The first Large-Scale Agile method, Disciplined Agile Delivery (DAD), was introduced in 2007 to expand organizational models that support: larger team size, geographical distribution, regulatory compliance, organizational distribution, technical complexity, domain complexity, organizational complexity, and enterprise discipline (Ambler, 2010).

Several Large-Scale Agile methods have since been introduced (e.g., Agile Portfolio Management [APM], Enterprise Scrum, Large Scale Scrum [LeSS], Nexus™, Recipes for Agile Governance in the Enterprise℠ [RAGE], Scaled Agile Framework® [SAFe®] and Scrum of Scrums [SoS]), each with the goal of quickly responding to organizational change and improving project success rates, but at a scale larger than what current Agile methods accommodate. Organizations are beginning to embrace Large Scale Agile methods for distributed teams, large projects, and critical systems (Ebert & Paasivaara, 2017). Large-Scale Agile Methods support the needs of organizations using the traditional approach while embracing Agile methods. These Large-Scale Agile Methods consider: larger team size, geographical distribution, regulatory compliance, organizational distribution, technical complexity, domain complexity, organizational complexity, and enterprise discipline (Ambler, 2010).

Although Disciplined Agile Delivery was the first Large Scale Agile Method, it has only been adopted by approximately 6% of organizations that have instituted Large-Scale Agile methods (CollabNet, 2019). The Scaled Agile Framework (SAFe®) at 30% is the most popular method cited in CollabNet's (2019) study and therefore was selected as the focus of this study. The next most widely reported methods are Scrum of Scrums (SoS) at 16%, and internally developed methods at 8%.

Statement of the Research Problem

Research around the newer Large-Scale Agile software development methods is underway but relatively nascent. While individual case studies related to Large-Scale Agile methods have been published (Fitzgerald et al., 2013; Goh et al., 2013), many case studies regarding the effectiveness of various large-scale agile methods were conducted by the organizations that promote the associated method. The adoption rate of Large-Scale Agile methods has also been surveyed (PMI, 2016; VersionOne, 2019).

A critical gap remains in the literature. Independent case studies on the effectiveness of Large-Scale Agile software development methods in cross industry large-scale research are missing. If improvements using Agile methods (39% successful) over the Waterfall method (11% successful) helped pave the way for the more recent Large-Scale Agile software development methods, then it is important to know whether Large-Scale Agile methods, specifically SAFe®, result in even greater success and what factors contribute to that success.

Purpose of the Study

This study's purpose is to determine the extent of perceived effectiveness of the Scaled Agile Framework® in software development organizations using Complex Adaptive Systems as a lens to guide the study. SAFe® was selected because it is the most widely adopted Large-Scale

Agile method (CollabNet, 2019) and its adoption rate has grown every year for the past 5 years. In addition, the 2019 Gartner Report on Enterprise Agile Planning Tools shows most of the leading vendors (e.g., Atlassian, Broadcom, Digité, IBM, ServiceNow, VersionOne) are including support for SAFe® in their enterprise planning tools.

Due to the high cost of software development project failure, coupled with the fact that the literature suggests failure rates of software development projects are closely tied to the software development method, the purpose of this mixed methods exploratory case study is to examine the extent of perceived effectiveness of the Scaled Agile Framework (SAFe®) in software development organizations using Complex Adaptive Systems as a lens to guide the study. In order to measure effectiveness, it is important to understand "that there is no one single theory of effectiveness. Rather, there are multiple models, each of which has a legitimate claim to being the key approach for defining and determining the effectiveness of an organization" (Cameron, 2013, p 553). There appears to be, however, general agreement over the years that organizational effectiveness considers the efficiency with which an organization fulfils its objectives without placing undue strain on its members and / or society (Georgopoulos & Tannenbaum, 1957; Manzoor, 2011; Thibodeaux & Favilla, 1996). The core component of efficiency in achieving organizational objectives helps guide the research questions and associated methods of inquiry.

Theoretical Perspective

Theory plays a critical role in research by providing a verifiable foundation for future research (Rocco & Hatcher, 2011). Complex Adaptive Systems (CAS) theory was selected as a lens for this study due to its applicability with the underlying organizational constructs related to the use of SAFe® as a large-scale agile method for software development projects and the

research questions selected. CAS and its applicability are presented below. Due to the complexity of the work performed by software development organizations and the myriad factors in achieving organizational agility, the CAS theory was selected as a guide to help define the type of data and methods for data collection.

Applicability of Complex Adaptive Systems Theory

Many authors describe both the software development process (Highsmith & Cockburn, 2001; Meso & Jain, 2006; Nerur et al., 2005; Vidgen & Wang, 2006) and the management of the information systems in which the resultant software resides as CAS (Nilsson & Darley, 2006; Serugendo et al., 2011). While related, this paper focuses on the former, the software development process using SAFe®.

CAS are systems that have a large number of components (aka agents) that interact and adapt or learn (Holland, 2002). CAS are generally defined as being composed of self-organized "populations of adaptive agents whose interactions result in complex non-linear dynamics, the results of which are emergent system phenomena" (Brownlee, 2007). In the context of software development, there are many agents (customers, management, developers, testers, etc.) that interact to define and refine both the software product or service and the process used to deliver that product or service. As depicted in Figure 1, the concepts of self-organization, non-linearity, and emergence are core characteristics (Lewin, 1999). In addition, a CAS is responsive to the changing internal and external environment through (positive and negative) feedback cycles (Kaisler & Madey, 2008).

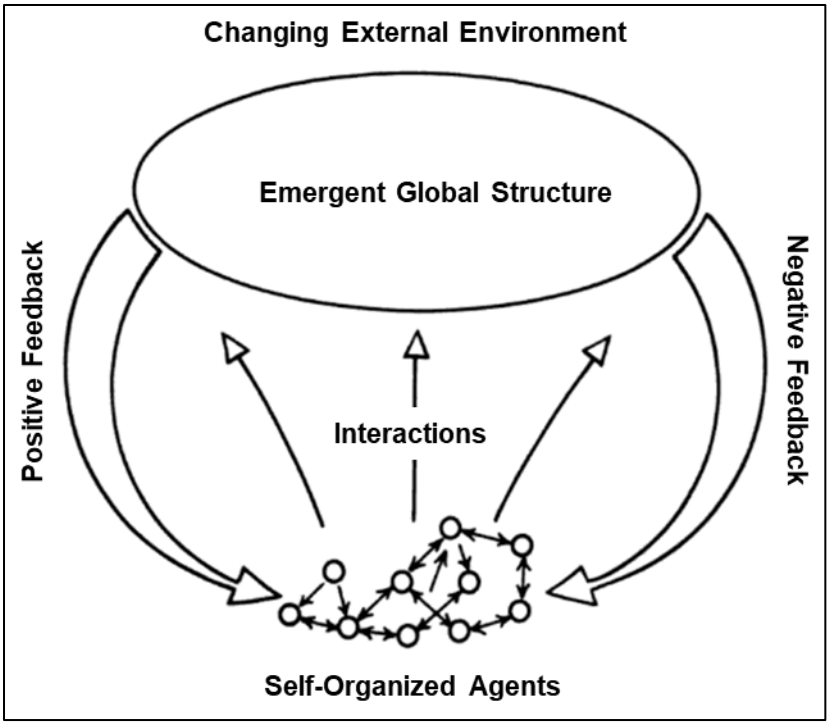

Figure 1. Complex Adaptive Systems Theory.

Note. Reprinted from "Complexity: Life at the edge of chaos," by Lewin, R., 1999, University of Chicago Press, p. 13. Copyright 1999 by Roger Lewin. Reprinted with permission.

This section aligns the characteristics of the CAS theory (self-organization, non-linearity, and emergence [Lewin, 1999]) to SAFe®. It also describes the responsiveness of SAFe® to the changing external environment through (positive and negative) feedback cycles (Kaisler & Madey, 2008).

Self-Organizing. One of the core principles of Agile software development (the underlying method of SAFe®) is that of self-organization (Fowler & Highsmith, 2001). Moe et al. (2008) describe Agile teams as requiring a high level of both individual and team autonomy. The Agile Manifesto underscores this with "innovation and creativity in human organizations are best generated from self-organizing teams in which the interactions are high, and the process rules are few" (Fowler & Highsmith, 2001). The terms Scaled Agile Framework (SAFe®) and

self-organizing may initially appear to be contradictory. Scott Ambler (2010), author of the first published Large-Scale Agile method Disciplined Agile Delivery (DAD), wrote "self-organizing teams must work within an 'appropriate governance framework' that reflects the needs of their overall organizational environment" (p. 15). He defined self-organizing as "the people who do the work also plan and estimate the work" (p.7).

Non-Linear. Non-linear refers to both interactions of agents in the network and non-corollary cause effect continuum. Within SAFe®, a complex and nonlinear influence network of entities (customers, stakeholders, and other enterprises) is present through various agent interactions (Atkinson & Moffat, 2005). For example, when eliciting requirements for software systems, people use the same words to express very different concepts. Briggs and Grünbacher (2002) describe this as the "proliferation of semantic and consequential meanings" (p. 22) that increases the complexity of the requirements being sought. The networks themselves create complexity. This is exacerbated by the number of stakeholders providing input into the system requirements.

Non-linear also refers to the non-corollary cause effect continuum. Ahimbisibwe et al. (2015) conducted a literature review of 148 articles related to software development and found 37 critical success factors. Due to the complexity of software development, and the number of factors, very few have been able to describe those with statistical significance (Cao, 2006).

Emergent. SAFe® supports emergence in that the development teams are responsive to the emerging changes in requirements through feedback loops from short development cycles and frequent releases and integration (Meso & Jain, 2006). Alaa and Fitzgerald (2013) describe emergence in Agile methods as the interactions between agents lead to a system of emergent response.

Responsive. SAFe® traverses the organization at the Portfolio, Program and (Project) Team levels (Laanti, 2014) and considers both internal and external stakeholders and environmental variables (Alqudah & Razali, 2016). Dingsøyr and Moe (2014) wrote a principle of large-scale agile includes: "Continuously feedback from the portfolio to project levels enables the teams and project members to take decisions that are consistent with the goals of the large-scale agile portfolio" and "continuous feedback from the project level to the portfolio level enables changing the portfolio to optimize the value of the large-scale agile portfolio" (p. 6). Responsiveness, "Responding to change over following a plan", is also a core value in the Agile Manifesto (Fowler & Highsmith, 2001, p. 1).

Research Questions

This study focused on evaluating the extent of perceived effectiveness of the Scaled Agile Framework® in software development organizations using Complex Adaptive Systems as a lens to guide the study. The purpose of this research is to understand if organizations employ SAFe® for software development if they experience a positive increase in overall organizational effectiveness. Organizational effectiveness considers the efficiency in which organizations produce intended outcomes. The underlying methods of inquiry focus on collecting information considering organizational efficiency and the achievement of objectives. The primary research question is supported by five subordinate research questions that consider areas of effectiveness in software development organizations based on Complex Adaptive Systems theory. This mixed methods exploratory case study is guided by the research questions below:

- RQ1: What is the extent of perceived effectiveness of the Scaled Agile Framework® in software development organizations?

- RQ1a: How and to what overall perceived effect are software development organizations using SAFe® to measure organizational outcomes?
- RQ1b: How and to what overall perceived effect are software development organizations using SAFe® to manage self-organization/self-organized teams?
- RQ1c: How and to what overall perceived effect are software development organizations using SAFe® to manage non-linear relationships?
- RQ1d: How and to what overall perceived effect are software development organizations using SAFe® to manage emergent requirements?
- RQ1e: How and to what overall perceived effect are software development organizations using SAFe® to support organizational agility?

A multiple case study design enabled the usage of multiple methods (e.g., Interviews, Quantitative Surveys, Observation, Document Reviews) to address the research questions listed above. The methods section later in this document provides additional detail. Qualitative interview and quantitative on-line survey questions are presented in Appendix A and B. The instruments were reviewed and approved by the Dissertation Committee and University's Institutional Review Board before data was collected and analyzed.

Significance of the Study

While the effectiveness of Agile Methods on software development project success is well documented (PMI, 2016; The Standish Group, 2015; VersionOne, 2017), much less literature was found describing the effectiveness of Large-Scale Agile Methods on software development projects. Research has linked software development project success to three primary factors: Organizational, Process and People/Job Performance (Chan & Cao, 2008; The

Standish Group, 2015) with Organizational factors at 64% having the greatest impact on the success rates (The Standish Group, 2015). Given this significance, the research investigates whether SAFe® support organizational agility leading to increased software development success.

Building upon success rates of software development projects using Agile methods, coupled with the need to manage software development projects at scale, many organizations are turning to SAFe® today. While the adoption of the new Large-Scale Agile methods has been the subject of several studies, studies regarding the effectiveness of these methods are still nascent. This research is intended to fill a gap in the current literature regarding the extent of perceived effectiveness of the Scaled Agile Framework®. The outcome of this research is intended to inform academics and practitioners on the extent of perceived effectiveness of SAFe® and to identify if gaps remain in the organizational success factors for future study and evolvement of the method using Complex Adaptive Systems as a lens to guide the study.

Statement of Assumptions

Assumptions for this study include:

- The use of random sampling yields a more homogeneous sub-population of participants than simple random selection. This approach provides increased support for comparison of existing and future studies.
- The quantitative survey questions from the University of Southern California, Marshall School of Business are relatively free of intentional and unintentional bias (Fowler, 2013).

- The survey instrument from the University of Southern California, Marshall School of Business is a valid instrument for this study based on prior studies where the Cronbach's alpha was greater than or equal to 0.8 (Garson, 2012).
- Information elicited from persons providing information for this study was to the best of their knowledge and is assumed to be accurate (Nardi, 2018).

Statement of Delimitations

This study is subject to the boundaries as follows:

- This study is focuses on perceive effectiveness relative to the software development function within an organization and not on overall organizational success.
- Study participant organizations were selected after the approval from the Institutional Review Board based on the Dissertation Committee's review and approval.
- Study participant organizations were based on a set of criteria provided in the Methods section.
- A minimum of two software development organizations were selected and included in this study.
- Study participants were only selected from the United States of America to reduce potential regional and cultural considerations.
- The focus of this study is on the use of the Scaled Agile Framework (SAFe®) as it is the most widely adopted Large-Scale Agile method at 30% according to CollabNet's 2019 survey. In addition, the 2019 Gartner Report on Enterprise Agile Planning Tools shows most of the leading vendors (AgileCraft, Atlassian, Broadcom, Digité, IBM, ServiceNow and VersionOne) are including support for SAFe® in their planning

tools and does not show any specific support for other major Large-Scale Agile Methods.

- The primary researcher's post-positivist worldview and over 30 years of information technology experience was considered in the development and analysis of this research. Researcher bias is addressed by 1) using an independently developed quantitative survey instrument and 2) collaborating with a group of certified SAFe® professionals to refine the qualitative interview questions.
- The information regarding SAFe® presented in this study is limited to the literature review and information gathered from a survey and individual interviews.
- Data collected for this study were gathered between September 1 and December 15, 2020.
- Sample bias is possible due to the population selected.

Definition of Terms

Several terms, acronyms and abbreviations are used throughout this paper, this section provides the definitions for each presented.

- Agile Method – Methodology to provide continuous delivery of valuable software (Fowler & Highsmith, 2001).
- Agile Release Train (ART) – "A long-lived team of Agile teams, which, along with other stakeholders, incrementally develops, delivers, and where applicable operates, one or more solutions in a value stream" (Scaled Agile Inc., 2020).
- Agile Release Train Sync (ART Sync) – Meeting where "Scrum Masters and Product Owners review the program Kanban system and pull in more work based on the available capacity at each state. Participants discuss new work, prioritize, schedule

meet-afters, and make deployment and release decisions as needed" (Scaled Agile Inc., 2020).

- Burnup Chart – "A burn up chart is a visual diagram commonly used on Agile projects to help measure progress. Agile burn up charts allow project managers and teams to quickly see how their workload is progressing and whether project completion is on schedule" (Everett, 2020).
- Information Systems (IS) – "A discrete set of information resources organized for the collection, processing, maintenance, use, sharing, dissemination, or disposition of information" (44 U.S.C. Sec. 3502, p. 120). This term is often used interchangeably with Information Technology.
- Information Technology (IT) – "Any equipment or interconnected system or subsystem of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information" (44 U.S.C. Sec. 3502, p. 120). This term is often used interchangeably with Information Systems.
- Large Scale Agile Methods (also Agile @ Scale or Scaling Agile Methods) – Methods to expand Agile teams to support: larger team size, geographical distribution, regulatory compliance, organizational distribution, technical complexity, domain complexity, organizational complexity, and enterprise discipline (Ambler, 2010).
- NAICS Code – North American Industry Classification System (NAICS) is used by the United States, Canada, and Mexico to classify businesses by industry (U.S. Census Bureau, n.d.).

- Organizational Agility – "the ability to detect and respond to opportunities and threats with ease, speed, and dexterity" (Tallon & Pinsonneault, 2011, p. 464).
- Organizational Effectiveness – The extent to which an organization, by the use of certain resources, efficiently fulfils its objectives without depleting its resources and without placing undue strain on its members and/or society (Manzoor, 2011).
- Organizational Performance – The Baldrige National Quality Program defines an "organization's performance and improvement in its key business areas: customer satisfaction, financial and marketplace performance, workforce, product/service, operational effectiveness, and leadership. The category also examines how the organization performs relative to competitors" (Hook et al., 2017, p. 7).
- Organizational theory – The study of how organizations function and how they affect and are affected by the environment in which they operate (Jones, 2013).
- Product Owner – "The Product Owner (PO) is a member of the Agile Team responsible for defining Stories and prioritizing the Team Backlog to streamline the execution of program priorities while maintaining the conceptual and technical integrity of the Features or components for the team" (Scaled Agile Inc., 2020).
- Product Owner Sync – "The purpose is to get visibility into how well the ART is progressing toward meeting its PI objectives, to discuss problems or opportunities with Feature development, and to assess any scope adjustments" (Scaled Agile Inc., 2020).
- Product Success – Measures the usefulness of the project's final product as measured actual usage (Ambler, 2018; Beck et al., 2001, El Emam & Koru, 2008; Eveleens & Verhoef, 2009; Gemino et al., 2007; Sheffield & Lemétayer, 2013; Thomas &

Fernández, 2008), customer satisfaction (Aronson et al., 2013; Hagen & Park, 2013; Joslin & Müller, 2015; Serrador & Pinto, 2015; Sheffield & Lemétayer, 2013) and system usage (El Emam & Koru, 2008; Eveleens & Verhoef, 2009; Gemino et al., 2007).

- Program – A program is "a collection of change actions (projects and operational activities) purposely grouped together to realize benefits" (Thiry, 2015, p. 15).
- Program Increment – "A Program Increment (PI) is a timeboxed planning interval during which an Agile Release Train plans and delivers incremental value in the form of working, tested software and systems. PIs are typically 8 – 12 weeks long" (Scaled Agile Inc., 2020).
- Program Increment Planning – "Program Increment (PI) Planning is a cadence-based, face-to-face event that serves as the heartbeat of the Agile Release Train (ART), aligning all the teams on the ART to a shared mission and Vision" (Scaled Agile Inc., 2020).
- Program Management – Is the "action of carrying out the coordinated organization, direction and implementation of a dossier of projects and transformation activities to achieve outcomes and realize benefits of strategic importance to the business" (Office of Government Commerce, 2013, p. 4).
- Project Management – Project Management is "the application of knowledge, skills, tools, and techniques to project activities to meet project requirements" (PMI, 2017, p. 5).
- Project Quality – "The degree to which a set of inherent characteristics fulfills requirements" (PMI, 2017, p. 718).

- Project Success – Three criteria must be met for the project success to be deemed successful including: delivered on schedule, on budget and providing the scope determined at the onset (baseline) of the project. Projects that do not fully meet all three criteria are considered challenged and those that do not deliver a final product are categorized as failures (Ambler, 2018; El Emam & Koru, 2008; Gemino et al., 2007; The Standish Group, 2015, PMI, 2017; Sauer et al., 2007).
- SAFe® – Scaled Agile Framework. "The Scaled Agile Framework encompasses a set of principles, processes and best practices that helps larger organizations adopt Agile methodologies, such as Lean and Scrum, to develop and deliver high-quality products and services faster" (Alexander, 2019).
- Scrum – A framework within which people can address complex adaptive problems, while productively and creatively delivering products of the highest possible value (Sutherland & Schwaber, 2017).
- Software Development – Software development is an iterative logical process that aims to create a computer coded or programmed software to address a unique business or personal objective, goal or process (Technopedia.com, n.d.).
- Strategic Alignment – The "degree to which the information technology mission, objectives, and plans support and are supported by the business mission, objectives, and plans" (Reich & Benbaset, 2000, p. 82).
- Strategic Objectives – The "aims or responses that your organization articulates to address major change or improvement, competitiveness or social issues, and business advantages" (Scott, 2016).

- Strategic Themes – “Differentiating business objectives that connect a portfolio to the strategy of the Enterprise. They influence portfolio strategy and provide business context for portfolio decision-making” (Scaled Agile Inc., 2020).
- Story Points – A “Story Point is a measure for relatively expressing the overall size of a user story or a feature. The value of the Story Point is dependent on the development complexity, effort involved, and the inherent risk” (Coelho & Basu, 2012).
- Technical Debt – “Technical debt is a metaphor for immature, incomplete, or inadequate artifacts in the software development lifecycle that cause higher costs and lower quality in the long run” (Seaman & Guo, 2011).
- Value Stream – The series of steps dedicated to build and support a set of internal or external solutions (the products, services, or systems) delivered to the customer (Scaled Agile Inc., 2020).
- Velocity – “Velocity is a measure of the team’s progress rate. It is calculated by adding all the Story Points assigned to each user story completed by the team in the current iteration” (Coelho & Basu, 2012).
    - Waterfall Method – The Waterfall model is a sequential software development process model that follows defined phases using the software development life cycle's (SDLC) common steps. The Waterfall model enforces moving to the next phase only after completion of the previous phase (Technopedia, n.d.).

CHAPTER 2

LITERATURE REVIEW

The purpose of this mixed methods exploratory case study is to examine the extent of perceived effectiveness of the Scaled Agile Framework (SAFe®) in software development organizations using Complex Adaptive Systems as a lens to guide the study. Research shows that software development organizations that have transitioned to collaborative Agile methods are significantly more successful than those that use a Waterfall method (39% vs. 11% successful, respectively). It is now important to know whether Large-Scale Agile methods, specifically SAFe®, used to manage software development organizations, result in even greater success.

Organizational Design and Measurement

The study of how organizations should be designed and operate can be traced back through the centuries in the studies of hierarchical organizations as described by Jethro, father of Moses in 1491 BC and Sun Tzu's Art of War in 500 BC (Shafritz et al., 2015). Contemporary organizational theory, the study of how organizations function and how they affect and are affected by the environment in which they operate (Jones, 2013), has its roots in more recent pre- and post- Industrial Revolution works of early structural theorists Adam Smith, Daniel McCallum, Fredrick Winslow Taylor, Max Weber, and Henri Fayol (Carus Miranda, 2008; Őnday, 2016). It is difficult to define specifically when the study of organization development and efficiency as a distinct field of social inquiry was established, however, many agree Adam

Smith's *An Inquiry into the Nature and Causes of the Wealth of Nations* (1776), Frederick Taylor's publication of *The Scientific Method* in 1911, Henri Fayol's "Principles of Management" in his 1916 book *Administration Industrielle et General* (Pryor & Taneja, 2010) and Max Weber's essay "Bureaucracy", published posthumously in the early 1920's in *Economy and Society* are considered important foundational documents for this field of study (Clegg, 2012; Hunt, 2015; Godwyn & Gittell, 2011; Turner, 2002).

Organizations are often described in one of three topologies: Rational, Natural and Open systems models (Martz, 2013; Scott & Davis, 2015; Winiecki, 2010). An understanding of these models plays a critical role in developing the assessment criteria to determine organizational effectiveness (Jones, 2013). This section is not intended to be an exhaustive literature review of the three topologies, rather it is provided for contextual understanding of the theoretical constructs that lead to the lens from which this study derives measures of organizational effectiveness using Complex Adaptive Systems Theory.

This section begins with an overview of rational, natural and open systems theory models and then presents a more in-depth review of Complex Adaptive Systems theory and includes models for measurement of organizational effectiveness for each topology.

Rational Systems

Rational systems (also termed Bureaucratic [Carus Miranda, 2008], Closed [Zammuto, 2005] and Goal-based [Scott & Davis, 2015]) began to emerge in the early 20th century from around 1900 to the 1930s (Martz, 2013). Scott and Davis (2015) define the rational systems perspective as "organizations are collectivities oriented to the pursuit of relatively specific goals and exhibiting relatively highly formalized social structures." Rational systems share commonalities with the writings of Adam Smith whereas the division of labor and worker

specialization increase organizational efficiencies (Hunt, 2015). The predominant thought was that the goals of organizations could be achieved by using formal and bureaucratic methods and individuals were "rational" beings in such a way as to be almost mechanical (Carus Miranda, 2008). Using rational systems approaches, organizations and even entire societies were seen as physical machines that could be designed to fulfill predetermined and large-scale purposes (Winiecki, 2010). The predominant thought was the organization's purpose, goals and processes could be predefined and regulated using formal or bureaucratic methods (Jones, 2013; Scott & Davis, 2015; Winiecki, 2010). To illustrate the key elements of rational systems theories, the contributions of three key structural theorists including Frederick Taylor, Max Weber and Henri Fayol are presented below.

The father of Scientific Management, Frederick W. Taylor (1856-1915), was a mechanical engineer, efficiency expert and management consultant in the late 19th and early 20th century. His seminal work, *The Principles of Scientific Management* (1919) opened with the core evangelistic purpose of his concept that "THE principal object of management should be to secure the maximum prosperity for the employer, coupled with the maximum prosperity for each employee" (Taylor, 1919, p. 9). The Scientific Method provided a wide array of management practices that typified rational systems and included: "task specialization, assembly line production practices, job analysis, work design, incentive schemes, person-job fit, and production quotas and control" (Giannantonio & Hurley-Hanson, 2011). The four core principles of Scientific Management are (Hassan, 2012):

1. Use true science for each element of a job to replace the old rule of thumb method.
2. Apply scientific selection, education, training and worker development for every job.

3. Distribute almost equally work and responsibility. Separating planning and work with management performing planning and workers executing the plans.

4. Support cooperation between management and workers to ensure that work is done in accordance with the principles of the science for each planned job and tasks.

Taylor's practices focused on the maximization of organizational economic gains through rationalized production processes (Taylor, 1919). Taylor is quoted "that the art of management is knowing exactly what you want men to do, and then seeing that they do it in the best and cheapest way" (Mogenson, 1949, p. 66). The method involved using time and motion studies with the goal of increasing outputs to discover the fastest, most efficient, and least fatiguing production methods. The goal was to determine "one best way" to perform common functions and subsequently organizing the business around that method (Shafritz et al., 2015). As described in the opening stanza of his book, Taylor focused on productivity-based pay for workers to create "maximum prosperity for each employee" (Taylor, 1919, p. 9).

The impact of the scientific management during the early 20th century was significant. Most manufacturing at that time was designed according to Taylor's principles, and even some white-collar jobs adopted elements of his approach (Jex & Britt, 2014). In addition, many organizations contracted with Taylor to help them implement this approach. Despite these successes, the scientific approach came under fire charged with being inhumane to workers. Taylor was called to a Congressional Hearing citing the Taylor system as "detrimental to the American workingman" where "none but the strong survive" (United States Congress, 1911). Regardless of the controversy, Taylor's data driven approach to solve business problems is a key component in business today (Lohr, 2013).

Maximillian Karl Emil (Max) Weber (1864-1920) was a German academic who studied history and law. He started as a professor of economics at the University of Frieburg and later at the University of Heidelberg (Crossman, 2020). In 1903, he became the associate editor of the *Archives for Social Science and Social Welfare* (Baehr, 1997). Weber started publishing papers in this journal, most notably "The Protestant Ethic and the Spirit of Capitalism", which became his most famous work and was later published as a book (Barbalet, 2008). His interests in social sciences led him to cofound the German Sociological Association. Today, Max Weber is considered, along with Karl Marx, Émile Durkheim, W.E.B. DuBois, and Harriet Martineau, as one of the founders of sociology (Cole, 2019).

Weber was an enthusiastic traveler and delivered lectures through the UK and Europe. As a sociologist, Weber was interested in the development, structure, interaction and collective behavior of organized groups of human society (Crossman, 2020). Max Weber was very interested in Taylor's work on industrialization and his interests and some of his writings were specifically focused on how industrialization affects society (Hatch, 2018). He observed the West was leading with the rise of nation-state in its rapid industrialization overseen by corporations (Thompson, 2017). To further his studies regarding industrialization, he, along with his wife Marianne, traveled to the United States. His essay "Bureaucracy", published posthumously, in large part due to the efforts of his wife Marianne, in the early 1920's in *Economy and Society* laid the groundwork for many historians and structural theorists that followed. Weber noted that the rationalized legal and administrative systems and the rise of public and private-sector bureaucracies were an important indicator of the benefits and values of this system.

Max Weber's concept of modern bureaucracy is what he called as an "ideal type" of organizational structure where he sought to specify a set of characteristics that could be tested against historical and current realities (Roth & Weber, 1976). Bureaucracy has three groups of characteristics that include the structure and function, a means for rewarding efforts, and protections for office-holders (Lutzker, 1982). These characteristics included (Carus Miranda, 2008; Shafritz et al., 2015):

- Clear differentiation of tasks and responsibilities
- Coordination via a strict hierarchy of authority using a firmly ordered system of super and subordination.
- Standardized decision-making rights, policies and procedures by official jurisdictional areas
- Vertical separation of planning and execution
- Use of technical criteria for recruiting and promoting technical staff

While Weber was a proponent of this rationalized form of organizational design, he wrote about concerns with strict adherence to such a system. His writing provides a warning about an "iron cage" in which every human can become a "cog in an ever-moving mechanism" (Hatch, 2018, p. 25). Critics echo this refrain in their writings regarding the bureaucratic rational model for organizational design (Hamilton, 1991).

Henri Fayol (1841-1925) was a French mining engineer and administrative theorist who was recognized for his successful turn-around as the CEO of a failing French mining company (Hatch, 2018). While admired for his work in the mining industry in France, Fayol was not widely well known until his book *Administration Industrielle et General* was published in 1916 (Pryor & Taneja, 2010). When the book was translated in English as *General and Industrial*

Management it gained wider acclaim (Fayol & Storrs, 1949). Today, Henri Fayol's "Principles of Management" in his 1916 book are considered the original foundation for management as a discipline and as a profession (Pryor & Taneja, 2010).

The book, *General and Industrial Management* was based upon principles he used throughout his career and he believed were "universally applicable to the rational administration of organizational activities" (Hatch, 2018, p. 33). In the book Fayol discussed five functions and 14 principles of management across six organizational areas (Fayol, 1949, p. 3):

- Technical activities (production, manufacture, adaptation).
- Commercial activities (buying, selling, exchange).
- Financial activities (search for and optimum use of capital).
- Security activities (protection of property and persons).
- Accounting activities (stocktaking, balance sheet, costs, and statistics).
- Managerial activities (planning, organization, command, coordination, control).

Fayol noted that all activities and essential functions in an industrial organization, whether it is simple or complex, can be classified into these six areas. Fayol was also considered the first to advocate for management education (Pryor & Taneja, 2010). His separation of technical and managerial activities laid the groundwork for the emergence of management science as a distinct discipline. His Administrative Management Theory described the benefit in management decision making by applying five core elements: Planning, Organizing, Commanding (Leading), Coordination, and Controlling, where the overall strategy is to be effective and efficient (Ehiobuche & Tu, 2012, p. 324).

Fayol's 14 principles of management were developed to guide a successful manager. They are: division of work, authority, discipline, unity of command, unity of direction,

subordination of individual interests to the general interests, remuneration, centralization, scalar chain, order, equity, stability of tenure of personnel, initiative, and esprit de corps (Shafritz et al., 2015, p. 53). Fayol dedicated six pages in his own book on Taylor's ideas and was generally quite complementary, but a significant difference in Fayol's principles from those of Taylor and Weber in that the "unity of command" and "esprit de corps" focused on group dynamics. While Weber predicted an ideal organization as a completely impersonal organization with little human level interaction between its members and Taylor focused on rewarding individual efforts, Fayol argued that it took the combination of personal efforts and team dynamics to create the ideal organization (Ehiobuche & Tu, 2012).

The benefits of the rational systems model may sound firm with a focus on goals and a command and control hierarchical structure for governance and oversight, however, there are many limitations. A major limitation of the rational systems approach is that considers the attainment of a goal as the sole criterion for performance without considering goal specificity, measurement, partial completion, importance weighting, conflicting goals, constraints, and impartiality of those setting the goals (Martz, 2013). Another limitation is the rational model considers internal and external environmental variables under the control of the organization itself (Winiecki, 2010). Organizations structured in this manner lack agility and would require significant effort to react to external change considering the goals, individual actions and organizational structure are fixed and the external environment was not a focus area.

Organizational effectiveness under rational systems was achieved by 1) defining the goal specifications with unambiguous criteria 2) prescribing the actions and rules for each individual and 3) establishing a formal structure for individual contributor performance evaluations against the previously established expectations (Carus Miranda, 2008; Martz, 2013, Őnday, 2018).

Natural Systems

Natural systems arose in response to the limitations and impacts on workers of rational systems approaches (Carus Miranda, 2008; Winiecki, 2010). Criticisms of Taylor and the realization of Weber's warning regarding the "iron cage" and "impersonal organization with little human level interaction between its members" (Ehiobuche & Tu, 2012, p. 324) led to the need for a human centered management approach. The emergence of human resources approach is attributed to the work of Australian George Elton Mayo (along with Roethlisberger and Dickson) in his involvement in a series of human centered research projects at the Western Electric Company, Hawthorne Works, outside of Chicago (Jenkins, 1940).

Mayo's interest in this area stem from his observations of industrial workers unrest in Australia. Mayo "argued that the worker's morale, or mental health, depended on his perception of the social function of his work" (Bourke, 1986), in other words if workers thought their work was valued they would be more content and perform better. Elton Mayo came to the United States to attend the University of Pennsylvania's Wharton School in 1922 on a grant. One of his first studies was to identify explanations for high turnover rates at a textile mill (Robertson & Carothers, 2016). This work attracted the interest of the Harvard School of Business Administration where he was later appointed as an associate professor in 1926 and promoted to full professor of Industrial Studies in 1929. His work at Harvard brought him into the study at the Western Electric Company, Hawthorne Works.

Between 1927 and 1932, the Hawthorne Studies took place at the Western Electric Company's Chicago Plant. The study focused primarily on women who assembled telephone equipment (Pyöriä, 2005). Mayo, a key member of the research team along with his associates, graduate student Fritz Roethlisberger (later Harvard Professor) and William J. Dickson, Manager

for Personnel Research at Western Electric, were among the very first to show how formal and informal patterns of worker and management interaction are equally crucial for organizations (Macefield, 2007). The primary objective of the Hawthorne Studies was to examine how different work conditions affected employee productivity. Experiments began with the plant's physical environment, adjusting lighting and humidity, later moving on to changing working hours, break times and lengths, and finally the leadership style of the manager (Robertson & Carothers, 2016). The researchers initially found productivity increases in the changes to environmental conditions, but quickly realized the increases were not due to that change but some other reason (Macefield, 2007).

Mayo published his findings in his 1933 book *The Human Problems of an Industrial Civilization*, he wrote "the individual workers and the group as a whole had to adapt themselves to a new industrial milieu in which their own self-determination and their social well-being ranked first and the work itself was incidental" (p. 73). In 1945, Mayo published *The Social Problems of an Industrial Civilization*, where wrote reflectively that the experiment "was responsible for many important findings – rest periods, hours of work, food, and the like: but the most important finding of all was unquestionably in the general area of teamwork and cooperation" (p. 82).

Fritz Roethlisberger and William J. Dickson also collaborated in 1939 on a book to share their findings entitled *Management and the Worker.* In this book they describe their findings regarding working conditions, employee relations, understanding employee satisfaction, the social organization of employees and how to apply the research to organizational practices.

Research on natural systems has consistently found organizational efficiencies were influenced when workers perceive collective versus individual benefits, they are more willing to

participate and sustain organizational initiatives (Winiecki, 2010). As a result, research in natural systems has led to the development of organizational cooperation, culture, leadership, motivation and teamwork studies (Carus Miranda, 2008; Pyöriä, 2005).

Organizational efficiency measurements under the natural systems construct include: natural systems model (measured by obtaining necessary resources), internal processes model (measured by cohesiveness of individuals in working on internal processes), and strategic constituencies model (measured by satisfying stakeholders) (Cameron, 2015).

Open Systems

The natural system perspective led to more interactions within organizations through informal structures which naturally led to the emergence of a recognition of the need to understand the impact of an organization's interaction with the external environment (Carus Miranda, 2008). Open systems models arose from the Karl Ludwig von Bertalanffy's research and observations in biological and ecological systems where he found organisms are interconnected and mutually influential (Winiecki, 2010). In the late 1920's Bertalanffy wrote: "Since the fundamental character of the living thing is its organization, the customary investigation of the single parts and processes cannot provide a complete explanation of the vital phenomena. This investigation gives us no information about the coordination of parts and processes" (Klir & Karnopp, 1972, p. 24). Bertalanffy posited that General Systems Theory could extend beyond biology and ecology as "universal principles applying to systems in general" (von Bertalanffy, 1968, p. 31).

The consideration of the interrelationships of "parts and processes" when applied to business organizations is in stark contrast to the earlier scientific method where each individual process and employee performance is assessed independently. However, the open systems

concepts are not distinct new methods (Bastedo, 2004), rather it is a different perspective that is applied to rational and natural systems resulting in four views (see Table 1):

Table 1

Open and Closed Systems Perspectives (adapted from Őnday, 2018, p. 250).

System Model	Characteristic	Key Contributors
Type 1: Closed Rational	Organizations portrayed as "tools to achieve preset ends" and largely ignore the impact of the environment.	Taylor, Fayol, Weber, and early Simon
Type 2: Closed Natural	Human relations centered focused on internal organizational actions.	Mayo, Dalton, Barnard, Roy, Whyte
Type 3: Open Rational	Includes bounded rationality, agency theory, contingency theory, comparative structural analysis, and transaction cost analysis.	Fiedler, Mitnick, Ross, Simon, Selznik, Thompson, Zald
Type 3: Open Natural	"Organizing" theory, negotiated order, organizational learning, socio-technical systems, strategic contingency, population ecology, resource dependency, Marxist theory, institutional theory, and postmodernism	Anderson, Emery, Hickson, Kleiner & Roth; Marx, Odum, Powell & DiMaggio; Pfeffer & Salancik; Scott, Strauss, Weick

Whether rational or natural, the common aspect of open systems is that they regularly exchange feedback with its external environment. Since open systems are systems inputs, processes, outputs, goals, assessment and evaluation, and learning are all important (McNamara, 2006). The interactions may include exchanges of material, energy, people, capital and information with the environment (Scott & Davis, 2007). Healthy open systems continuously exchange, analyze and adjust internal systems based on external conditions to achieve internal goals (McNamara, 2006). The open systems frameworks are continuing to evolve and emerging as complex organizational theories.

As organizational designs have changed, new models of organizational effectiveness have also emerged based on the general underlying concepts of each design. Models of organizational effectiveness in the open systems era included the (Cameron, 1986): Competing

Values Model (measured by means-ends; internal external focus, control flexibility [Henri, 2004]), Legitimacy Model (considers the survival or demise of organizations), Fault-Driven Model (reducing faults or areas of ineffectiveness), and the High Performing Systems Model (measured against other similar organizations). Two important organizational performance assessment models that arose from this era that are still in use today are the Burke-Litwin Model of Organizational Performance and Change and the Rummler-Brache Nine Performance Variables framework.

Burke-Litwin Model. Originally presented as "A Causal Model of Organizational Performance and Change" (Burke & Litwin, 1992), the model was based, in part, on Litwin's early work with Robert Stringer (1968) linking employee performance and morale to organizational climate (see Figure 2).

The purpose of this tool is to help understand an organization's components and their relationship in times of change. The model identifies two levels of change and 12 organizational variables or drivers of change. The first level, transformational change, happens due to changes in the environment and impacts the top half of the model (including external environment, mission and strategy, leadership and organizational culture). The second is transactional change, which impacts the lower portion of the model. Together or separately, transformation and transactional changes have an impact on individual and organizational performance. Together the twelve boxes that comprise the model are the primary areas for inquiry to gain an organizational understanding and support areas of analysis.

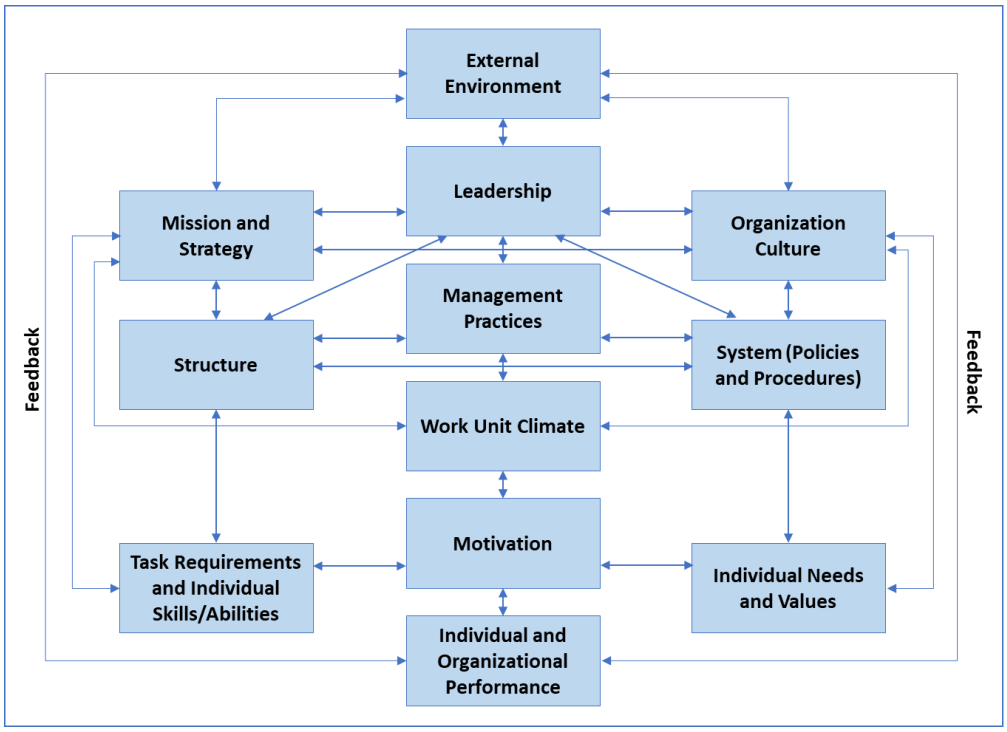

Figure 2. Burke-Litwin Model. *Note.* Reprinted from "*Organization change: Theory and practice*," by Burke W. W., 2018, Sage Publications, p. 227. Copyright 2018 by W. Warner Burke. Reprinted with permission.

Although the Burke-Litwin Model was originally developed in 1972, the model has stood the test of time. In the fifth edition of *Organizational Change theory and Practice* (2018), Burke writes in the Preface: "Fundamentals of organization change are still fundamental" (p. xiii).

Rummler-Brache Nine Performance Variables framework. Originally published in 1990, the Rummler-Brache Nine Performance Variables matrix is still very relevant today. Organizations can use this tool to assess each of the nine variables presented in the matrix to attain an overall view of organizational performance and areas requiring focus. The model is comprised of variable at three levels of performance and three performance needs (Rummler & Brache, 2013).

The three levels of performance constitute one dimension of the framework and include organization, process and job/performer levels. The organization level considers variables that affect organization-wide performance by assessing the strategy, goals and measures, structure and deployment of resources. The process level includes variables beyond the functional organizational arrangements and assesses workflow in terms of inputs, processes, outputs and cross team/cross-functional processes. This consideration is a critical component of the model and harkens to the subtitle "*how to manage white space in the organization chart*." At the job/performer level, an assessment of practices including hiring, promoting, responsibilities, standards, feedback rewards and training are considered (Rummler & Brache, 2013).

The three performance needs are the second dimension of the framework. These include goals, design and management. Goals include standards and measures the reflect customer expectations. Design considers the structure and supporting processes to support efficiencies to achieve the goals. Management at all three levels assesses practices and governance and oversight structures to oversee the achievement of the goals. Presented as a matrix, the nine performance variables (see Figure 3) can be used to provide a holistic view to examine performance in organizations.

		THE THREE PERFORMANCE NEEDS		
		Goals	Design	Management
THE THREE LEVELS OF PERFORMANCE	Organization Level	Organization Goals	Organization Design	Organization Management
	Process Level	Process Goals	Process Design	Process Management
	Job/Performer Level	Job/Performer Goals	Job/Performer Design	Job/Performer Management

Figure 3. Rummler-Brache Nine Performance Variables.

Note. Reprinted from "*Improving Performance: How to manage the white space on the organization chart,*" by Rummler, G. A. and Brache, A. P., 2013, Josey Bass, p. 16. Copyright 2013 by John Wiley & Sons. Reprinted with permission**.**

Complex Adaptive Systems

Modern complexity theories related to natural and social systems originated by a group of distinguished scientists with backgrounds in particle physics, microbiology, archaeology, astrophysics, paleontology, zoology, botany, and economics in the early 1980s at the Santa Fe Institute in New Mexico, USA (Pascale et al., 1999). The scientists labeled the theories "complex adaptive systems" to describe how the living world works (Pascale et al., 1999). John Miller and Scott Page (2009) wrote "the field of complex systems challenges the notion that by perfectly understanding the behavior of each component part of the system we will then understand the systems as a whole" (p. 3).

Examples of CAS include natural systems (e.g., brains, immune systems, ecologies, societies) and artificial systems (parallel and distributed computing systems, artificial intelligence systems, artificial neural networks, evolutionary programs) (Chan, 2001). This section expands upon the descriptions of the components of CAS from Chapter 1.

Self-organizing. Self-organization is a bottom-up process where an organization emerges at multiple levels based on interactions of lower-level entities. This concept is counter to the

standard, top-down engineering design paradigm where planning precedes implementation, and the desired final system is known at the onset (Kaisler & Madey, 2008). The components (agents) within the organization adapt to respond to their environment. To qualify as an adaptive agent two criteria must be present: 1) the actions of the agent can be assigned a value (performance, utility, payoff, etc.), and 2) the behavior of the agent increases its value over time (Holland & Miller, 1991). There are four primary ways of adapting (Odell, 2008): Reaction - a direct, predetermined response to an event or an environmental signal.

- Reasoning - ability to make inferences.
- Learning - change that occurs during the lifetime of an agent.
- Evolution - change that occurs over successive generations of agents.

Non-Linear. Non-linearity refers to the both the interaction of agents in a CAS and the non-corollary relationship of inputs. CAS are characterized as having nonlinear spatio-temporal interactions. The interactions can be thought of as a network of dynamical elements where the states of both the nodes and the edges can change, and the topology of the network itself often evolves in a nonlinear fashion (Surana et al., 2005). Non-linearity also describes scenarios where non-corollary relationships exist. For example, a change of given magnitude in the input to the system is not necessarily matched in a linear manner to a corresponding change in output (Choi et al., 2001).

Emergent. The concepts of self-organization and emergence are closely tied. The collective effect of numerous actions among the semi-autonomous yet interdependent agents sets the stage for “emergence.” Emergence refers to unanticipated features and behaviors that “emerge” only as individual entities are aggregated and interact (Roundy et al., 2018). Holland (2002) adds that a CAS adapts and learns as experience accumulates, supporting emergence. The

system behavior emerges from activities and behaviors of the components of the system, however, this cannot be explained at the agent level alone (Kaisler & Madey, 2008). As such, emergent properties exist only at the aggregate level and are not obvious extrapolations of the properties of the individual elements (Roundy et al., 2018).

Responsive. In a CAS, there is no separation between a system and its environment in that a system always adapts to a changing environment (Chan, 2001). As an example, the traits in systems may change in response to environmental changes, which, in turn, changes the processes and consequently the structure of the system (Norberg, 2004). The cycle of adaption and emergence found in a CAS therefore cannot be separated from the (positive and negative) feedback provided from the environment in which the CAS exists (Kaisler & Madey, 2008).

Complex Adaptive Systems are characterized as having dynamic, non-linear, non-corollary relationships (Surana et al., 2005). Because of this, the individual interactions (i.e., independent variables) continually emerge within the system (DeLone & McLean, 1992). Organizational effectiveness measurements for CAS therefore consider the organizational goals (inputs) and the outcomes (outputs) of the system. The outcomes are described in the literature as "success criteria" (Westerveld, 2003).

The applicability of Complex Adaptive Systems Theory to this study is presented in the Introduction section of this document. Considering the complexity of organizations, with the CAS lens, this study focuses on the perceived overall impact or outcomes of the use of SAFe® on organizational effectiveness.

Software Development Methods

Software development methods, like organization design topologies, are influenced by several factors. The selection of a software development method is dependent upon scope, cost,

schedule, risk and stakeholder considerations (Andrei et al., 2019; PMI, 2017). Burgan and Burgan (2017) describe a continuum of project life cycles that span from predictive to adaptive. The characteristics of the project life cycles are reflected in the chosen software development method. This section begins with a discussion of the types of projects and then provides information regarding the associated software development approaches.

Predictive life cycles are characterized by having well defined requirements at the on-set of the project and change is constrained as much as possible. The key stakeholders in this type of project are involved primarily at the on-set and at specific milestones as the project progresses (Andrei et al., 2019). A predictive life cycle is generally used when the risks are considered lower due to a fair amount of certainty at the beginning of the project (PMI, 2017). The Waterfall approach in software development is such a method.

An iterative approach is used where the product is developed in short repeated cycles, where an incremental approach successively adds to the functionality of a project (Burgan & Burgan, 2014). Both approaches may either tend to align more closely with the predictive or adaptive approaches depending upon the cost, scope, schedule, risk and stakeholder involvement of each approach (Andrei et al., 2019; PMI, 2017). Incremental and iterative approaches include: Rapid prototyping, Spiral Development, V-Model Development, Rapid Application Development (RAD) (Oleksandrova, 2018).

Adaptive approaches are characterized as having frequent delivery of a sub-set of the overall product, scope elaborated (and reprioritized) frequently, continuous involvement of key stakeholders, and risks controlled as requirements emerge (PMI, 2017). Adaptive, also known as Agile methods, include: Unified process, Dynamic Systems Development Method, Scrum, Extreme Programming (XP), Crystal and Feature Driven development (Oleksandrova, 2018).

The mid-2000s ushered in a new group of Large-Scale Agile Methods that include: Disciplined Agile Delivery (DAD), Nexus™, Recipes for Agile Governance in the Enterprise (RAGE), Large-Scale Scrum (LESS), Agile Portfolio Management (APM), Lean Management, Scrum of Scrums (SoS), and Scaled Agile Framework (SAFe®) (Version One, 2018). The Large-Scale Agile Methods were introduced to take advantage of the higher success rates of Agile vs. Waterfall and to scale Agile beyond small project teams (Ambler, 2010).

Despite the rise in adoption rates of Agile methods, Waterfall is still very prevalent in business today. A PMI (2016) study of 3,234 global professionals described their use of Waterfall for all project types at 78% (12% always, 39% often, 27% sometimes, 22% rarely/never). A 2019 study from Slash Data found 37% of software development projects using a form of Waterfall (Swanner, 2019). Scrum, at 58% of Agile methods used (VersionOne, 2019), is the primary Agile method in use today. Scrum hybrid methods made up another 18% (for a total of 76%) of the Agile methods in use. SAFe® at 30% (VersionOne, 2017) is the most popular Large-Scale method.

Based on these statistics and because Scrum is a key component of SAFe®, the following section provides a brief overview of Waterfall, Agile (Scrum) and Scaled Agile Framework (SAFe®) methods.

Waterfall

The Waterfall method, one of the earliest software development methods, is attributed to the work of Herbert Benington in 1956 and is widely used today in government projects and many major companies (Munassar & Govardhan, 2010). As depicted in Figure 4, Waterfall leverages a hierarchical organization structure where a portion of the process (Conception, Initiation, Analysis, Design, Construction, Testing, and Maintenance, [Royce, 1970]) is performed by one

part of the organization and when finished, the work passes to the next team (Balaji & Murugaiyan, 2012).

This method was introduced because it offered more control than earlier ad hoc and trial and error methods, and comprehensive documentation is available for the next process step. A central problem with Waterfall is that the scope of work is determined at the onset of the program; and those fixed requirements are cascaded throughout the life cycle (Ji & Sedano, 2011). Waterfall assumes that once the requirements are defined in the Analysis Phase, all ambiguities are cleared and there is an unobstructed path to completion. However, in most real-world cases, this has not proven to be true due to changes in environmental and customer requirements (Andrei et al., 2019). Applying the Burke Litwin model, one could argue that the waterfall method primarily considered transactional dimensions and the lack of a transformational perspective (i.e., specifically the customer and market facets) created challenges using this model. This closed view, like the closed systems view in Bureaucratic organizational models, is a major disadvantage of Waterfall.

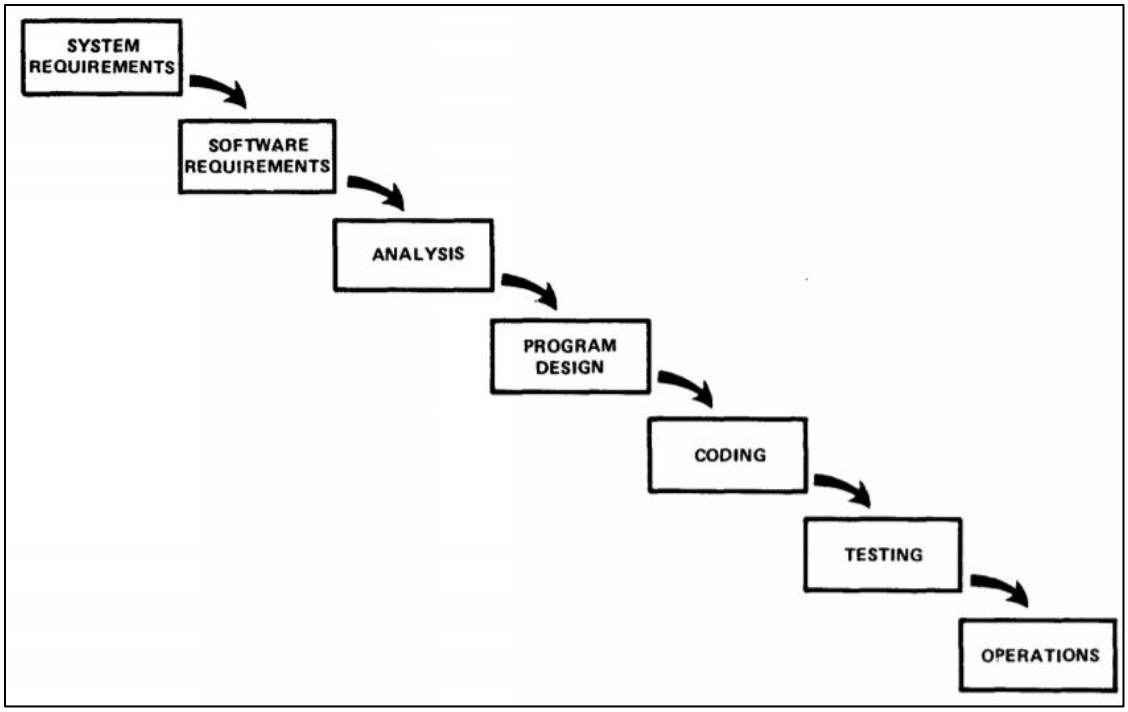

Figure 4. Waterfall Project Life Cycle.

Note. Reprinted from "Managing the development of large systems: Concepts and techniques.," by Walter Royce, 1970, 9th International Conference on Software Engineering. ACM, p. 329. Copyright 1970 by Walter Royce. Reprinted with permission. ***Agile Methods***

Collaborative software development methods, collectively termed "Agile methods", evolved after different incremental and iterative approaches aimed at increasing project success rates were introduced in the late 1980s. Agile methods were developed in the late 1990s (Ruparelia, 2010) and are used today by Technology, Financial Services, Professional Services, Insurance, Government, Healthcare and Pharmaceutical, Industrial/Manufacturing, Telecommunications, Energy, Education, Retail, Transportation, Media/Entertainment and Non-profit industries (CollabNet, 2019). Agile methods, as the name implies, were introduced to increase organizational agility by supporting the need to respond quickly to change and minimizing rework found in traditional methods (Barlow et al., 2011). Using Agile methods, the

full software development lifecycle is performed by a small collaborative work team, generally smaller than 15 people (Ambler, 2010). Teams can respond quickly to change because they develop software incrementally, in short time-boxed development cycles or "sprints", and they focus on developing the highest priority features in one- to six-week delivery increments (Schwaber & Beedle, 2002). The most widely used Agile method today is Scrum.

The Scrum Method. Scrum originated in Japanese manufacturing in 1986 when Hirotaka Takeuchi and Ikujiro Nonaka published the article, "New New Product Development Game" (the double "New" is indeed part of the title) in the Harvard Business Review (Lynch, 2019). The authors were seeking a commercial product development method to increase speed and flexibility. They likened Waterfall to a relay race where product wasn't ready until the hand-offs were complete. They argued that using a rugby approach, "the product development process emerges from the constant interaction of a hand-picked, multidisciplinary team whose members work together from start to finish" (Takeuchi & Nonaka, 1986, p. 138). This "new new" approach would allow for feedback and changes through shorter iterative and incremental development cycles.

Jeff Sutherland, inspired by the work of Takeuchi & Nonaka, applied this process to software development while working at Easel Corp and is credited with originating the first software Scrum project in 1993 (Lynch, 2019). Sutherland, working with Ken Schwaber, developed Scrum as a formal process in 1995 (Larman & Basili, 2003). Later the two would contribute to *The Agile Manifesto* in 2001 which would become the core framework for Agile methods. The Agile Manifesto articulates four key values (See Figure 5) and 12 principles that its authors believe software developers should use to guide their work.

Figure 5. Agile Manifesto Values.

Note. Reprinted from "Manifesto for agile software development.," by Beck et al., 2001, Agile Alliance, http://agilemanifesto.org/. Copyright 2001 by Agile Alliance. Reprinted with permission.

In 2010, Sutherland and Schwaber collaborated again to produce *The Scrum Guide™* (Sutherland & Schwaber, 2017). A Scrum Team consists of three primary roles: The Product Owner (internal or external customer), the Development Team (cross functional team of analysts, engineers, developers, and testers) and a Scrum Master (servant leader for the team). Scrum Teams are self-organizing in that the teams decide how best to accomplish their work and cross-functional in that they have all competencies needed to accomplish the work with dedicated resources within the team (Sutherland & Schwaber, 2017).

Scrum is executed in short iterations of work, called Sprints, lasting between one and four weeks (Moe & Dingsøyr, 2008). A sprint employs four different scrum ceremonies to ensure proper execution: sprint planning, daily scrum, sprint review and sprint retrospective (see Figure 6). These scrum ceremonies are outlined below (Malsam, 2019; Pries & Quigley, 2010):

- Sprint Planning: Team meeting to decide the work for the next sprint
- Daily Scrum: 15-minute daily meeting to discuss the completed and planned work and any roadblocks.
- Sprint Review: The customer demonstration of the work completed in the Sprint.
- Sprint Retrospective: This is when the team reviews their work, identifying what they did well and what didn't go as planned, so they can make the next sprint better.

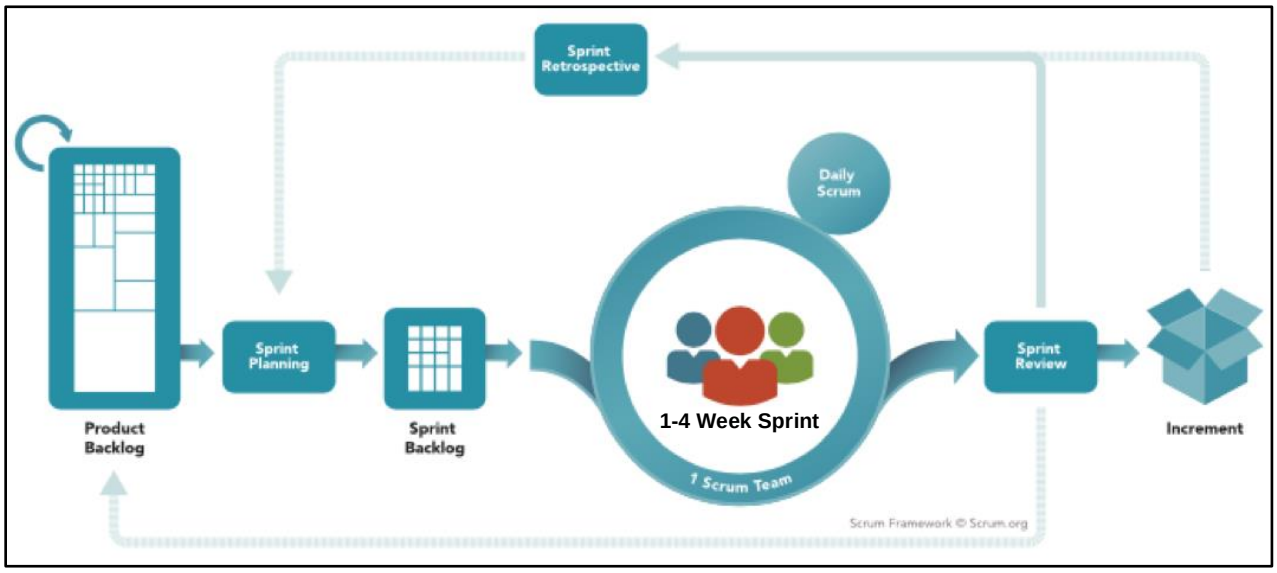

Figure 6. The Scrum Framework.

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Scrum offers several advantages over Waterfall. The primary benefit is that Scrum, by working in short-time phase releases (under 4 weeks), can accommodate changes in the environment and in customer priorities faster. With a dedicated multifunctional team, the resources, over time, gain a full life cycle view of the product and business rather than viewing only a portion at a time. Scrum however, does have some disadvantages. The primary disadvantage of these include generally less documentation than their Waterfall counterparts. Documentation may help other development teams come up to speed faster and make the transition to operational support teams easier. Also, by using small dedicated teams, teamwork is imperative for the success (Mahalakshmi & Sundararajan, 2013). Finally, Scrum is primarily focused on small teams and may not necessarily consider the broader organizational goals.

Another challenge with Scrum is that many organizations use both Agile and Waterfall methods concurrently. Because of this change, configuration management and aligning deployment schedules may be challenging. With Waterfall, the team knows what it will deliver (fixed requirements), but not specifically when it will deliver; with Scrum the team knows when they will deliver (time boxed), but not specifically what they will deliver, due to emergent scope (Bannink, 2014). Although Scrum harnesses the efforts of small, nimble teams, Chiyangwa and Mankandla (2017) suggested Agile software development projects fail primarily because the method focuses only on small teams and largely ignores the overall organization in which the teams operate. Large Scale Agile Methods have emerged to close this gap.

Large-Scale Agile Methods

Agile software development has become mainstream. Over 97% of 1,319 participants responding to VersionOne's annual State of Agile survey (CollabNet, 2019) report the use of Agile methods for software development in their organizations. Despite the prevalence of Agile

methods at the team level, most organizations still use traditional (Waterfall) methods at the organizational level today (Alqudah & Razali, 2016). Some of the challenges in transitioning to Large Scale Agile methods at the organization level include moving from (Waterfall) a hierarchical command and control structure where decisions are centralized; to Agile methods that include self-managed collaborative teams and decentralized decision making (Erikkson, 2015). The two methods "naturally pull in different directions" (Francino, 2017). An HPE study (2016) of 403 software development and IT professional found lower performance ratings and lower success metrics using this hybrid approach vs. a full Agile approach.

A group of "Large-Scale Agile" software development methods is starting to emerge. Public (Mergel, 2016; Moulton et al., 2017), private (Denning, 2018; Laanti, 2017) and non-profit (Duncan, 2018; Sandberg, 2018) organizations are interested in not only expanding upon the success of Agile methods at the team level but are also interested in introducing new governance and organizational oversight models (Alqudah & Razali, 2016). The first Large-Scale Agile method, Disciplined Agile Delivery (DAD), was introduced in 2007 to expand organizational models that support: larger team size, geographical distribution, regulatory compliance, organizational distribution, technical complexity, domain complexity, organizational complexity, and enterprise discipline (Ambler, 2010). Several Large-Scale Agile methods have since been introduced (e.g., Agile Portfolio Management [APM], Enterprise Scrum, Large Scale Scrum [LeSS], Nexus™, Recipes for Agile Governance in the Enterprise℠ [RAGE], Scaled Agile Framework® [SAFe®] and Scrum of Scrums [SoS]), each with the goal of quickly responding to organizational change and improving project success rates, but at a scale larger than what current Agile methods accommodate. Although Disciplined Agile Delivery was the first Large Scale Agile Method, it has only been adopted by approximately 6%

of organizations that have instituted Large-Scale Agile methods (CollabNet, 2019). The Scaled Agile Framework® (SAFe®) at 30% is the most popular method cited in CollabNet's (2019) study and therefore was selected as the focus of this study. The next most widely reported methods are Scrum of Scrums (SoS) at 16%, and internally developed methods at 8%.

Scaled Agile Framework® (SAFe®)

The Scaled Agile Framework encompasses a set of principles, processes and best practices to aid in the organization-wide adoption of Agile methodologies, such as Lean and Scrum, to develop and deliver high-quality software and systems faster at the project, program, and portfolio levels (Alexander, 2019). The first version of SAFe®, released in 2010 by software industry veteran and methodologist Dean Leffingwell, was called the "Agile Enterprise Big Picture" (Leffingwell, 2010). The current version, SAFe® for Lean Enterprises 5.0 was introduced in January 2020. SAFe® 5.0 is a significant update to the Framework that provides guidance on the seven core competencies that help an organization become a Lean Enterprise and achieve Organizational Agility (Scaled Agile Inc, 2020b).

Figure 7 depicts the current version of SAFe® (5.0). It is comprised of three configurations (i.e., essential, large solution and portfolio) listed as tabs across the top of the diagram, and seven core competencies listed on the left side and bottom of the diagram. Essential SAFe® is the core configuration where Large Solution and/or Portfolio Configurations can be added on top (Scaled Agile Inc., 2020c). All configurations include the organization, processes, roles and responsibilities of those involved in managing software and systems using SAFe® (Scaled Agile Inc., 2020c). SAFe® 5.0 made some significant changes to the overall framework from the prior version SAFe® 4.6. The two primary changes were the introduction of new core

competencies to focus on Lean and Agile and the combining of the Program and Team (project) levels into a single level configuration now called “Essential SAFe” (Scaled Agile Inc., 2020a).

The seven core competencies include six across all SAFe® configurations and one additional competency for large solutions that include (Scaled Agile Inc., 2020b):

- Organizational Agility – Aligning strategy and execution by applying Lean and systems thinking approaches to strategy and investment funding, Agile portfolio operations, and governance
- Lean Portfolio Management – Executing portfolio vision and strategy formulation, chartering portfolios, creating the Vision, Lean budgets and Guardrails, as well as portfolio prioritization, and road mapping
- Enterprise Solution Delivery – Building and sustaining the world’s largest software applications, networks, and cyber-physical solutions (included in large solution SAFe® configuration)
- Agile Product Delivery – Building high-performing teams-of-teams that use design thinking and customer-centricity to provide a continuous flow of valuable products using DevOps, the Continuous Delivery Pipeline, and Release on Demand
- Team and Technical Agility – Driving team Agile behaviors as well as sound technical practices including Built-in Quality, Behavior-Driven Development (BDD), Agile testing, Test-Driven Development (TDD), and more
- Continuous Learning Culture – Continually increasing knowledge, competence, and performance by becoming a learning organization committed to relentless improvement and innovation

- Lean-Agile Leadership – Advancing and applying Lean-Agile leadership skills that drive and sustain organizational change by empowering individuals and teams to reach their highest potential

SAFe® as a Large-Scale Agile method provides organizations a way to leverage Agile methods at scale, beyond only small teams (Ambler, 2010). SAFe® purports that integrating Agile methods at the program and portfolio levels offers a higher degree of organizational agility, by implementing a way for stakeholders across multiple groups to get feedback faster (Alexander, 2019). While SAFe® provides a way to manage multiple Agile efforts concurrently, critics are concerned about the level of detail and the size of the organizational structure required to support a SAFe® implementation. SAFe® is very detailed and somewhat prescriptive in that it contains agendas and schedules for individual meetings. Kalenda (2017) wrote “Its organizational structure is large, has several layers of hierarchy with a lot of defined roles and their responsibilities” (p. 23).

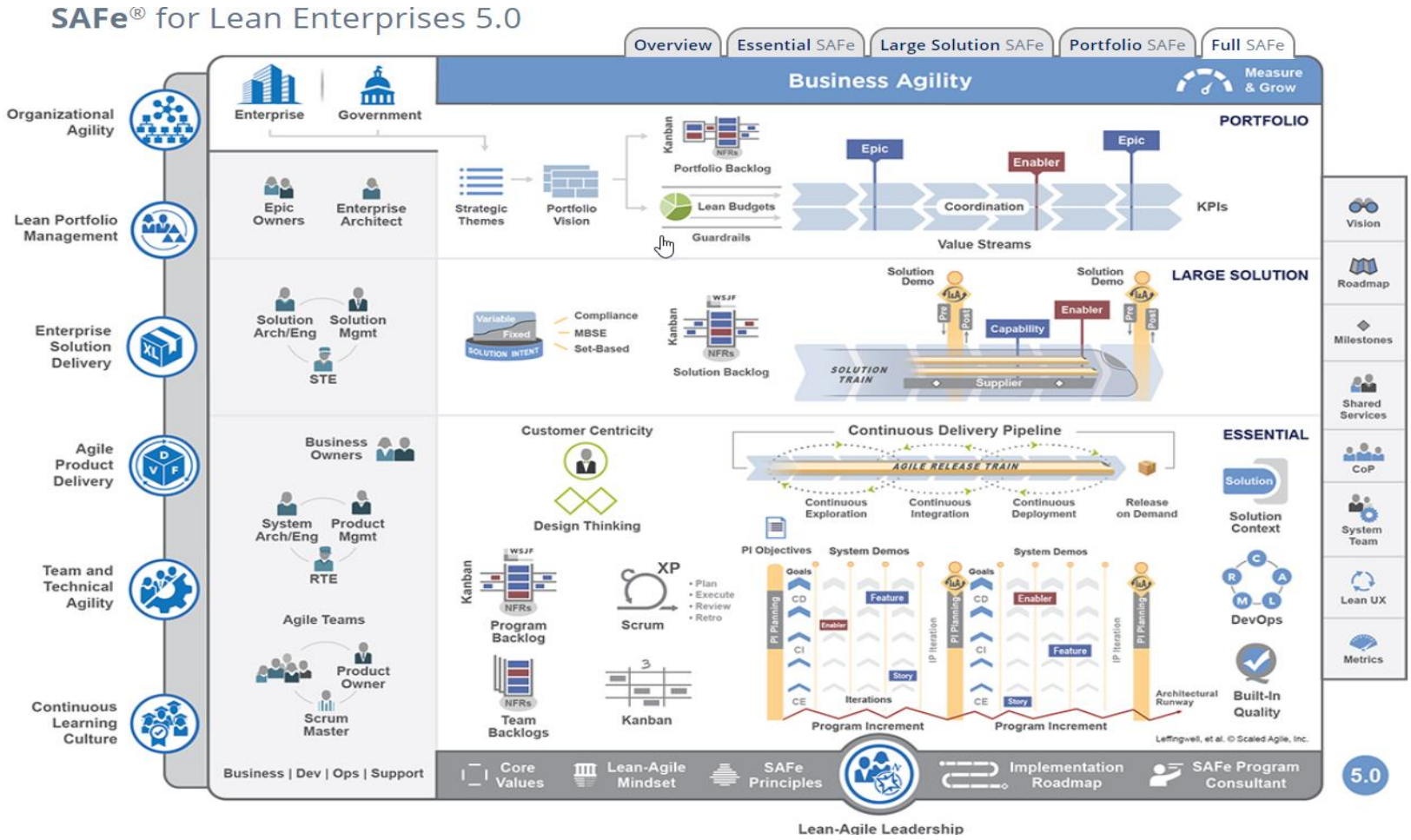

Figure 7. SAFe® for Lean Enterprises 5.0.

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Measuring the Effectiveness of SAFe®

This section presents literature supporting the measures for assessing the extent of perceived effectiveness of the SAFE® framework considering Complex Adaptive Systems theory. Earlier in this document, Complex Adaptive Systems (CAS) was presented with an overall discussion of the attributes of the theory that included self-organizing, non-linear, emergent and responsive. The overall understanding presented was also that of measuring impacts and outcomes versus individual interactions. This section aligns the considerations and presents supporting research questions to assess the extent of perceived effectiveness of SAFe®.

Table 2 provides a mapping of the CAS attributes to the research questions, Agile Manifesto values and the competencies in the SAFe® framework. Literature supporting each consideration is provided in the sections below.

Table 2

Measures of SAFe® Effectiveness

CAS Attribute	Research Question	Agile Manifesto Value	SAFe® Competency
Output / Outcome	RQ1a: Measure organizational outcomes	Working Software	Lean Portfolio Management
Self-Organizing	RQ1b: Managing self-organized teams	Individuals and Interactions	Lean-Agile Leadership
Non-linear	RQ1c: Managing non-linear relationships	Customer Collaboration	Agile Product Delivery
Emergent	RQ1d: Managing emergent requirements	Responding to Change	Continuous Learning Culture
Responsive	RQ1e: Managing organizational agility	Responding to Change	Organizational Agility; Team and Technical Agility

Producing Organizational Outcomes

Since the advent of modern information systems, many have sought to define common measures of information systems project success (Jugdev & Müller, 2005). Software development project

success criteria considers two distinct elements: project success and product success (Baccarini, 1999; Ghapanchi et al., 2011). Project success focuses on the successful accomplishment of the project, while product success measures the usefulness project's final product (Baccarini, 1999). The Agile Manifesto (Beck et al., 2001) provides a core value of "working software" as a primary measure of success. Collectively, project and product success measures are both important for characterizing the outcome of the software development project efforts. Three common resolution types are applied to categorize the effectiveness of a software development project as either successful, challenged or failed based on a set of selected success criteria (Ambler, 2018; El Emam & Koru, 2008; Gemino et al., 2007; Sauer et al., 2007; The Standish Group, 2015, PMI, 2016).

There is general agreement on three common criteria for *project* success that include being on schedule, on budget and providing the scope determined at the onset of the project. These project success measures (i.e., schedule, cost and scope) were originally termed "the triple constraint" or "iron triangle" of project management (Dobson, 2004). The Project Management Institute added resource and quality management as additional constraints in the 5th Edition of the PMBOK (PMI, 2013), however, the original measures (i.e., Schedule, Cost, and Scope) are commonly applied as objective measures across multiple studies (see Table 3). The management of schedule, cost and scope is "generally recognized" as a "good practice" by "most projects most of the time" (PMI, 2017, p. 2). Each criterion is baselined at the beginning of a project (or Agile Sprint) and tracked throughout the project lifecycle (PMI, 2017).

Table 3

Project Success Criteria

Reference	Method / Participants	Project Success Criteria
Agarwal and Rathod (2006)	Survey / 105	Schedule, Cost, Scope, Quality
Ambler (2018)	Survey / 149	Schedule, Cost, Scope, Usage
Aronson et al. (2013)	Survey / 193	Schedule, Cost, Scope, Customer Satisfaction
Berssaneti and Carvalho (2015)	Survey / 336	Schedule, Cost, Scope
Dvir et al. (2006)	Survey / 89	Schedule, Cost, Scope, Quality
El Emam and Koru (2008)	Survey / 156	Schedule, Cost, Scope, Usage
Eveleens and Verhoef (2009)	Case Study / 4 – 1824 projects	Schedule, Cost, Scope, Usage
Gemino et al. (2007)	Survey / 412	Schedule, Cost, Scope, Usage
Geoghegan and Dulewicz (2008)	Survey / 52	Schedule, Cost, Scope, Benefits
Hagen and Park (2013)	Survey / 123	Schedule, Cost, Scope, Customer Satisfaction
Hsu et al. (2011)	Survey / 128	Schedule, Cost, Scope, Quality
Joslin and Müller (2015)	Survey / 254	Schedule, Cost, Scope, Customer Satisfaction, Benefits
Mahaney and Lederer (2006)	Survey / 202	Schedule, Cost, Scope, Customer Satisfaction
Müller and Turner (2007)	Survey / 400	Schedule, Cost, Scope, Customer Satisfaction
PMI (2016)	Survey / 3,234	Schedule, Cost, Scope, Benefits
Raymond and Bergeron (2008)	Survey / 39	Schedule, Cost, Scope, Quality
Sauer et al. (2007)	Survey / 412	Schedule, Cost, Scope, Usage
Serrador and Pinto (2015)	Survey / 859	Schedule, Cost, Scope, Customer Satisfaction
Sheffield and Lemétayer (2013)	Survey / 106	Schedule, Cost, Scope, Usage, Quality, Customer Satisfaction
Thomas and Fernández (2008)	Interviews / 72	Schedule, Cost, Scope, Benefits, Usage
The Standish Group (2015)	Workshops / 50,000 projects	Schedule, Cost, Scope, Usage
Zwikael and Unger-Aviram (2010)	Survey / 81	Schedule, Cost, Scope, Customer Satisfaction

This study uses "system usage" as the single common *product* success criteria. This is consistent with the prior studies (see Table 3) in that this measure considers a Boolean response, either the system is delivered and is either used or it is not. This also aligns with one of the earliest widely accepted success models, The Technology Acceptance Model (Davis, 1985). Davis developed the model based Fishbein and Ajzen's (1975) work on attitude theory and this model described the most important measure of effectiveness is system use.

Multiple studies (Ambler, 2018; El Emam & Koru, 2008; Eveleens & Verhoef, 2009; Gemino et al., 2007; Sauer et al., 2007; PMI, 2016; Sheffield & Lemétayer, 2013) have leveraged the project resolution taxonomy developed by The Standish Group in their first "Chaos Report" survey from 1994. This taxonomy describes the performance of software development projects using three resolution types (see Table 4).

Table 4

Project Resolution Types (The Standish Group, 2015, p. 4; Gemino et al., 2007, p. 34).

Resolution Type	Success Criteria
Resolution Type 1: Successful	The project is completed on-time and on-budget, with all features and functions as initially specified (e.g., On Scope).
Resolution Type 2: Challenged	The project is completed and operational but either over-budget, over the time estimate, and offers fewer features and functions than originally specified.
Resolution Type 3: Failed	The project is cancelled at some point during the development cycle.

As described in Table 4, the resolution types require multiple conditions to be present to fit within each category. Relating the measures to the earlier discussion, schedule (on-time), and cost (on-budget), and scope (all planned features and functions), and not failed (i.e., not cancelled), must all be present for a project to be deemed successful. If any success criterion is

not fully met (except cancelled), then the project is categorized as challenged. Failed projects have only one criterion, that they were cancelled at some point during the development cycle. Figure 8 presents the coding for the survey questions and corresponding resolution type.

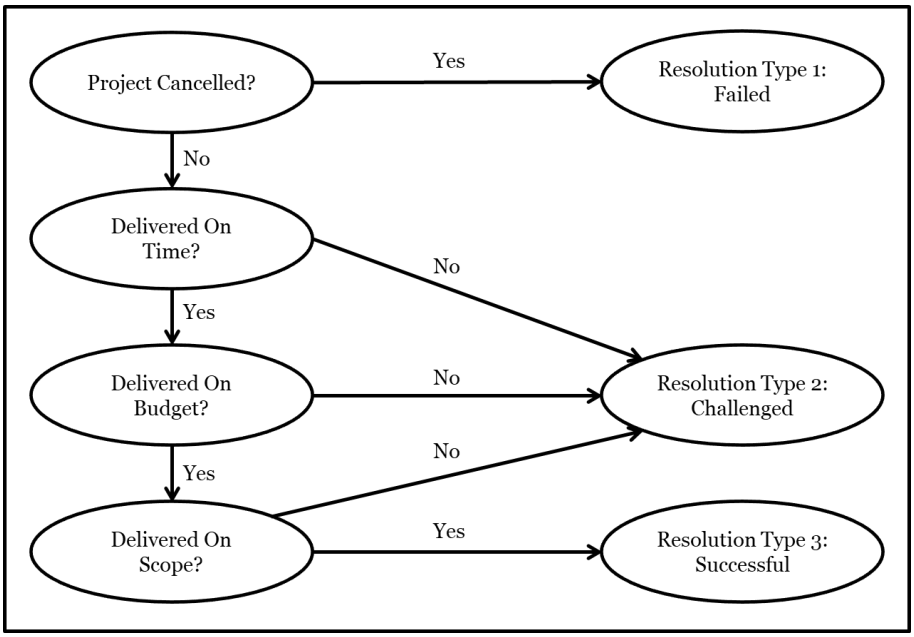

Figure 8. Project Resolution Coding is based on multiple project success criteria.

Note. Adapted from "Beyond chaos: Examining IT project performance.," Gemino et al., A., Sauer, C. & Reich, B., 2007, Proceedings of the 2nd International Research Workshop on Information Technology Project Management (IRWITPM), Montréal, Québec, Canada, p. 34. Copyright 2007 by Gemino, A., Sauer, C. & Reich, B. Adapted with permission.

Many authors point out concerns in The Standish Group's method. One notable concern is that The Standish Group's information is based on forecasts. Eveleens and Verhoef (2009) wrote Standish's "definitions heavily rely on the quality of forecasts; the definitions should account for the potential biases of predictions" (p. 8). El Emam and Koru (2008) conducted two studies of project cancellations in 2005 (232 responses) and 2007 (156 responses). The authors also noted a concern about forecasting in that "practitioners aren't using the best estimation tools

and techniques available" (p. 90). Gemino, Sauer, and Reich's (2007) UK study considers the variance from the expected cost, scope and schedule measures and presents their findings using both The Standish Group's criteria and their own. The major difference being that variances are averaged across all samples to present a "theoretical midpoint" for the metric. Finally, The Standish Group's (2015) report collects information on multiple projects from individual participants. Gemino, Sauer, and Reich (2007) suggest collecting information regarding a single, most recently completed project provided the best opportunity for collecting information of project related variances.

The questions for this area are regarding the setting, attainment, and alignment of goals, including the criteria (i.e., metrics) used to measure effectiveness. The specific research questions related this question are presented in the Methods section and questions in appendices.

Managing Self-Organizing Teams

Unlike the closed and bureaucratic systems models where individual tasks are defined and managed directly, SAFe® (and Agile) provides for self-organized teams. Self-organizing team members share a common goal and work is organized interdependently in small Scrum teams. SAFe® uses a Scrum Master as the "servant leader" who collaborates with the team to facilitate joint planning and the team members share responsibility for managing their own work and jointly share responsibility for problem-solving and continuous improvement (Mandal & Pal, 2015). This arrangement empowers the team members while reducing their dependency on top management as the team accepts accountability.

The self-organizing team structure places ownership and control close to the core of the work, which in turn, increases team responsiveness to change. SAFe® considers self-organization as a core component of lean management. Self-organization a core component at

the team level, within the Scrum team; at the Program level within the Agile Release Train; and at the Portfolio Level in the Solution Train (Scaled Agile Inc., 2020). Scaled Agile Inc shares the benefit of self-organization in that "This creates a far leaner organization; one where traditional daily task and project management is no longer required. Value flows more quickly, with a minimum of overhead" (Scaled Agile Inc., 2020).

The questions for this area are regarding the extent of perceived effectiveness of SAFe® on multiple self-organized teams at multiple levels and the perceived benefits or apparent gaps in using this model. Specific research questions related this question are presented in the Methods section and questions in appendices.

Managing Non-Linear Relationships

A core competency of SAFe® is that of Agile Product Delivery where the focus of building high-performing teams-of-teams are used to provide a continuous flow of valuable products (Scaled Agile Inc., 2020). The teams-of-teams considers both development teams and internal and external customers and other key stakeholders. Within SAFe®, the customer centricity is a core part of the overall model. This is facilitated by either direct customers or Product Owners and Product Managers at the team and program levels respectively. To properly represent customer interests, market segmentation, customer value maps, and stakeholder engagement matrices are developed and maintained (Scaled Agile Inc. 2020). Leadership teams are replicated at the portfolio, program and team levels with the specific goal of maintaining these relationships and aligning the products to the customer needs.

The questions for this area are regarding the extent of perceived effectiveness of SAFe® in managing various stakeholder communities. Specific research questions related this question are presented in the Methods section and questions in appendices.

Managing Emergent Requirements

A core competency of SAFe® is that of a continuous learning culture, where the teams continually increasing knowledge, competence, and performance and commit to improvement and innovation (Scaled Agile, Inc., 2020). Like the management of non-linear relationships, requirements are said to emerge from organizational goals, customer interactions, product goals, and requirements derived from the architecture and development teams themselves – where ever opportunities are identified. Emerging requirements, like others, are captured in backlogs and prioritized as a part of the process.

The questions for this area are regarding the extent of perceived effectiveness of SAFe® in managing emergent requirements. Specific research questions related this question are presented in the Methods section and questions in appendices.

Managing Responsiveness

SAFe® considers responsiveness in two of its core competencies – organizational and team agility. The concept of organizational agility grew from its roots in manufacturing as a necessary condition for competitiveness. The original concept, “agile manufacturing”, was popularized in 1991 by a group of scholars at Iacocca Institute of Lehigh University (Yusuf et al., 1999). Organizational agility is defined as “the result of integrating alertness to changes (recognizing opportunities/challenges) – both internal and environmental – with a capability to use resources in responding. (proactive/reactive) to such changes, all in a timely, flexible, affordable, relevant manner” (Alzoubi et al., 2011, p. 505). While initially developed for manufacturing, several authors (Conboy & Fitzgerald, 2004; Lu & Ramamurthy, 2011; Ngai et al., 2011) have applied this model to IT-based industries.

Organizational agility is closely tied to the Complex Adaptive System theory element of responsiveness. In a CAS, there is no separation between a system and its environment in that a system always adapts to a changing environment (Chan, 2001). One of the tenants of the Agile Manifesto is also that of responsiveness; “Responding to change over following a plan” (Fowler & Highsmith, 2001). Agile methods focus on the small collaborative work team at the project level, generally groups smaller than 15 people (Ambler, 2009). With the introduction of Large-Scale Agile methods, operating at the Portfolio, Program and Project levels (Laanti, 2014), this question addresses the impact on organizational agility given the increased breadth of organizational governance using Large-Scale Agile methods.

Roy Wendler (2013) reviewed 28 frameworks of agility and concluded “there is absolutely no consensus of what really constitutes the construct of agility” (p. 1170). Yauch (2011) found that organizational agility models differ in various ways where some: relate to specific business processes, emphasize agility across supply chains, focus on individual business units, and others focus on internal operational measures. Despite these concerns, there is consensus regarding the importance of organization’s ability to sense and respond to changes in the environment (Aburub, 2015; Bernardes & Hanna, 2009; Nafei, 2016; Roberts & Grover, 2012a; Sharifi & Zhang, 1999; Tallon & Pinsonneault, 2011; Zitkiene & Deksnys, 2018).

There have been many attempts to define a common approach to measuring organizational agility. Studies from Sharifi and Zhang (1999), Tseng and Lin (2011), and Zitkiene and Deksnys (2018) each defined organizational agility capabilities considering four core capabilities of responsiveness, competency, flexibility and speed. Tseng and Lin (2011) and Zitkiene and Deksnys (2018) also included stakeholder satisfaction a core capability. While listed separately, each capability is often intertwined with one another. Worley and Lawler

(2009) developed a framework for measuring organizational agility characteristics that focused on “robust strategy, an adaptable organization design, shared leadership, and a strong change capability” (p. 2) that leads to sustained performance.

After a review of several approaches to measure organizational agility (Aburub, 2015; Bhatt et al., 2010; Bendoly & Jacobs, 2004; Bernardes & Hanna, 2009; Chakravarty et al., 2013; Holweg, 2005; Hoyt et al., 2007; Kettunen & Laanti, 2008; Nafei, 2016; Nejatian & Zarei, 2013; PMI, 2016; Prasad & Green, 2015; Raschke, 2010; Roberts & Grover, 2012a; Shahrabi, 2012; Sharifi & Zhang, 1999; Tallon & Pinsonneault, 2011; Tseng & Lin, 2011; Worley et al., 2014a; Zelbst et al., 2011; Zitkiene & Deksnys, 2018), the “Organizational Agility Profiler Survey” developed by Worley, Williams, and Lawler (2014b) and governed by the Center for Effective Organizations (CEO), at University of California’s Marshall School of Business was selected. Several factors were considered when selecting the instrument to measure organizational agility. The instrument must: be applicable across multiple industries; consider recent research in organizational agility, have been used in multiple studies, have established a baseline for comparison against other organizations, and have been verified as reliable and valid across multiple studies.

Founded in 1979, the Center for Effective Organizations studied performance data from 243 large firms in 17 industries over the 30-year period from 1979 to 2009 (Worley et al., 2014a). More recently they have conducted organizational agility surveys including 4,700 directors and executive from 56 companies (Worley et al., 2014a). In addition to their own research, several dissertations (Brodtrick, 2016; Gagel, 2018; Najrani, 2016; Young, 2013) and research studies (Chermack et al., 2019; Mirinezhad et al., 2014) have also used the survey instrument developed by these authors.

The Organizational Agility Profiler survey is based on the research of Worley, Williams and Lawler (2014b) documented in *Assessing your organization's agility: Creating diagnostic profiles to guide transformation*. The survey is based upon four "routines" (see Table 5) that distinguish outperformers from underperformers.

Table 5

The Routines of Agility(Worley et al., 2014b, p. 27)

Routine	Description
Strategizing	How top management teams establish an aspirational purpose, develop a widely shared strategy, and manage the climate and commitment to execution.
Perceiving	The process of broadly, deeply, and continuously monitoring the environment to sense changes and rapidly communicate these perceptions to decision makers, who interpret and formulate appropriate responses.
Testing	How the organization sets up, runs, and learns from experiments
Implementing	How the organization maintains its ability and capacity to implement changes, both incremental and discontinuous, as well as its ability to verify the contribution of execution to performance.

Each of the routines described above can be measured as independent variables, with an equal weight attribution to the dependent variable, organizational agility (see figure 9). Questions related to each routine are provided in Table 5.

The questions for this area are regarding the perception of the level of organizational agility using SAFe®. Specific research questions related this question are presented in the Methods section and questions in appendices.

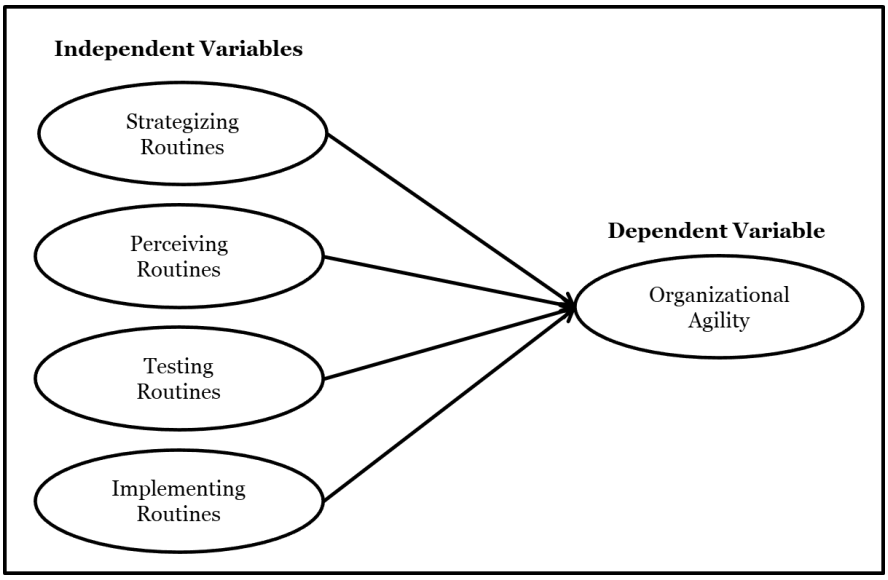

Figure 9. Organizational Agility Variables.*Note.* Adapted with permission from "The agility factor: Building adaptable organizations for superior performance.," by Worley, C. G., Williams, T., Lawler, E. E., 2014a, San Francisco, CA, Jossey-Bass. Copyright 2014 by Worley, C. G., Williams, T., Lawler, E. E. Adapted with permission.

CHAPTER 3

METHODOLOGY

The purpose of this mixed methods exploratory case study research was to examine the extent of perceived effectiveness of the Scaled Agile Framework® in software development organizations using Complex Adaptive Systems as a lens to guide the study. As discussed earlier, SAFe® was selected due to the percentage of organizations using it (over other Large-Scale Agile methods) and based on the number of enterprise planning tool vendors including support for SAFe® it in their products (Mann et al., 2019).

Research Method

The research method selected for this study was a mixed methods exploratory case study design using multiple cases. This approach was selected based a review of the research questions and the desire to provide a significant addition to the literature to both those interested in the effective use SAFe® in software development organizations and for those who seek to evolve the method. Creswell and Clark (2018) describe a key advantage of mixed methods case study design it that it provides in-depth and practical understandings and conclusions that are transferrable to other groups.

Yin (2018) wrote that case study research is selected when the primary research questions are 1) “How” and “Why” questions, 2) The researcher has little or no control over the events and, 3) the focus of the study is contemporary versus historical. This research meets these criteria

in that the research is primarily focused on “how” organizations are currently using the method to increase their effectiveness. Other mixed methods approaches were considered however, an exploratory case study design was selected due to the ability to supplement qualitative and qualitative approaches with evidence-based findings through direct observations, document reviews and metrics systems reviews. Stake (2013) adds that case study research is contemporary in that it provides an understanding of the experiences of the participants in their context and current situation.

Case Study Considerations

This study employs multiple methods to derive findings including: a quantitative approach using a validated existing survey and qualitative methods using multiple interviews at the portfolio, program and team levels of practitioners and potentially their customers and sponsors; observation in meetings; a review of documentation; and a review of program/project management metrics systems. A minimum of two software development organizations were required for this study. The findings from each were first assessed independently and then findings were compared to draw any contrasts or commonalities. By using this approach, the research achieves the benefits of multiple methods by validating quantitative findings (through interviews, observations findings, and evidence-based data collection) with qualitative methods (through a validated existing survey instrument) and augmenting the quantitative data with qualitative findings (Wisdom & Creswell, 2013). Wiggins (2011) asserts an advantage of the mixed methods approach, by using both quantitative and qualitative methods, is that the research benefits in offsetting the strengths and weaknesses of each method to better answer a research question or questions. Case studies provide additional observational methods including attending meetings, reviewing documents and reviewing management reporting systems used by the

organizations to report, track and measure progress to support triangulation to validate the findings. The benefits of the qualitative and quantitative approaches also included in case studies are described below.

Quantitative Components

A pre-existing validated survey was used to support the research question related to organizational agility. Nardi (2018) describes several advantages of quantitative survey research that pertinent to this study including: allows replication and comparison of earlier studies, provides the ability to reach large samples and address multiple topics and the supports anonymity when asking questions about opinions and attitudes. Considering the advantages described by Nardi (2018), this study leverages survey questions for organizational agility adapted with permission from the Center for Effective Organizations, University of Southern California, Marshall School of Business.

The adaptation changes the first part of the question to relate the instrument to this audience. Instead of starting the survey questions with “Traditionally, this organization…” the survey has been changed to read “Our software development organization, using SAFe®…” By using an existing survey instrument, results can be compared more readily against prior studies. The survey used for this study ahs also been validated by many prior studies. In addition, the intended audience of this study is presented information in a familiar context and format. Hyman et al. (2006) describe an advantage of using existing survey instruments is that the questions would have already been tested providing researchers additional confidence as indicators of their concepts of interest.

Qualitative Components

Choy (2014) describes advantages of a qualitative approach stating this approach may yield information that is more nuanced than data derived from surveys; and open-ended questions allow participants to discuss issues they deem most important. By using open-ended questions this gives participants the opportunity to respond in their own words, rather than having them choose a fixed response (Stuckey, 2013). The interview questions are based on research from the literature review and on outcome of a review of the questions with highly experienced SAFe® practitioners prior to conducting the interviews. When supplemented with the qualitative survey instrument, document reviews and observations, many of the shortcomings of single approaches are minimized.

Research Design

The theoretical framework, Complex Adaptive Systems (CAS), presented in the Introduction section guides overall research perspective (Grant & Osanloo, 2014). Based on the attributes of self-organization, non-linearity and emergence of a CAS, and measurement of specific intervention effects are required along with the measurement of the overall impact on the system (Boustani et al., 2010). Figure 10 depicts the relationships between the areas of inquiry for this study. To measure effectiveness, an understanding of the relationships of how organizational outcomes are defined, managed, measured and influenced by internal and external factors is required.

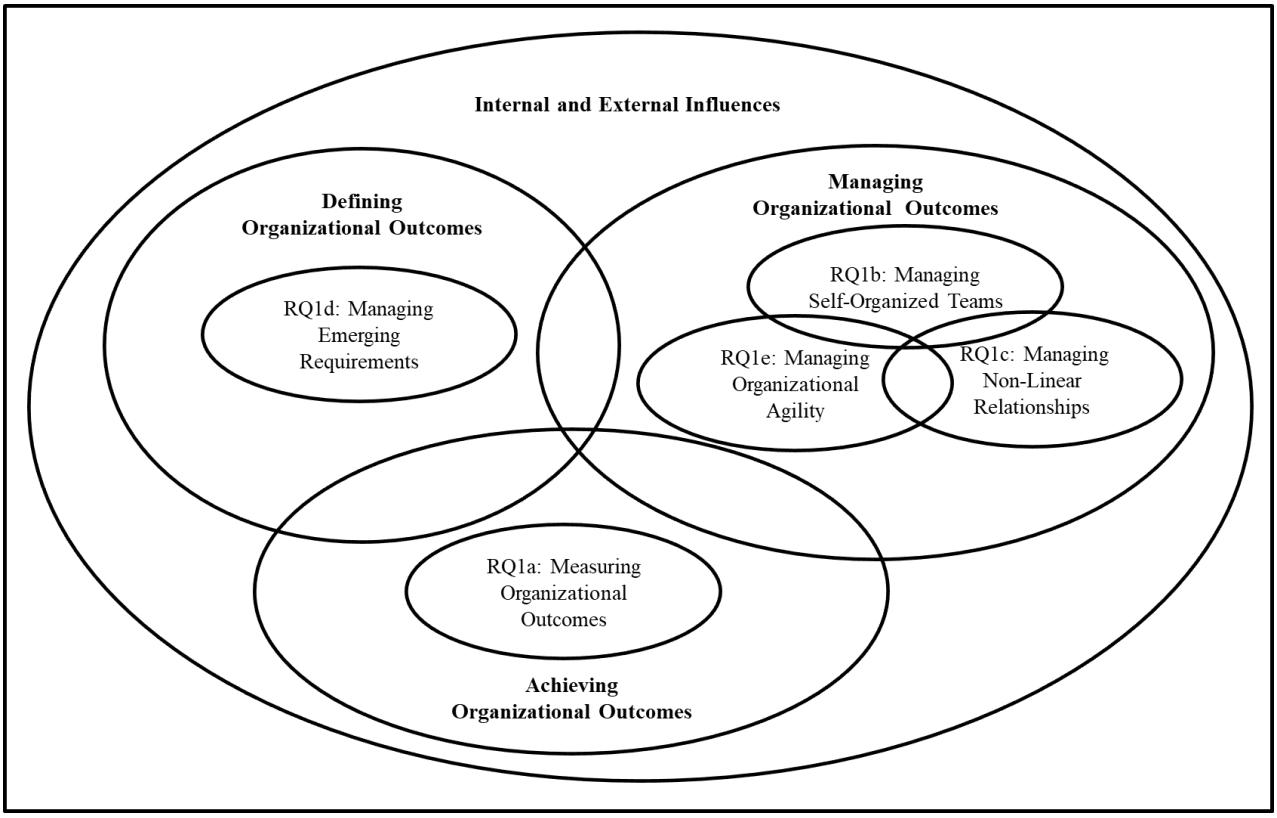

Figure 10. SAFe® as a CAS has multiple interrelated variables.

To assess SAFe® as a management framework for these considerations, one primary and five supporting research questions were selected to address the problem and purpose statements presented earlier. The primary research question was addressed with consolidated findings from the study. The supporting questions guide the areas of inquiry, and include:

- RQ1: What is the extent of perceived effectiveness of the Scaled Agile Framework® in software development organizations using Complex Adaptive Systems as a lens to guide the study?
    - RQ1a: How and to what overall perceived effect are software development organizations using SAFe® to measure organizational outcomes?

- RQ1b: How and to what overall perceived effect are software development organizations using SAFe® to manage self-organization/self-organized teams?
- RQ1c: How and to what overall perceived effect are software development organizations using SAFe® to manage non-linear relationships?
- RQ1d: How and to what overall perceived effect are software development organizations using SAFe® to manage emergent requirements?
- RQ1e: How and to what overall perceived effect are software development organizations using SAFe® to support organizational agility?

To answer the questions above, Table 6 presents the CAS attribute, research question, research method and approach selected. Supporting information is provided for each consideration in the sections below.

Table 6

Measurements of SAFe® Effectiveness

CAS Attribute	Research Question	Approach	Method
Output / Outcome	RQ1a: Measure organizational outcomes	Qualitative	Interviews, Observation, Document Reviews
Self-Organizing	RQ1b: Self-organization	Qualitative	Interviews, Observation
Non-linear	RQ1c: Non-linear relationships	Qualitative	Interviews, Document Reviews
Emergent	RQ1d: Emergent requirements	Qualitative	Interviews, Observation, Document Reviews
Responsive	RQ1e: Organizational Agility	Quantitative	On-Line Survey

This section aligns the research questions to specific questions and measures for each question, it also includes the coding used to assess the responses and presents the resultant survey and initial interview questions that were presented to study participants.

Instrumentation

This section describes the instruments and interactions used in this mixed-methods exploratory case study for data collection. The interview questions and areas of observation are discussed first, followed by the online survey questionnaire.

Interviews and Observations

The interview questions were developed to address the first four research questions regarding the components of a Complex Adaptive Systems (i.e., organizational outcomes, self-organization, non-linear relationships and emergent requirements). The interview questions were supplemented by observations through follow up meetings and email correspondence. This section provides a detailed description of the considerations leading to the interview questions and interactions. The resultant questions and observations for the first four research questions are provided in Appendix A.

Measuring Organizational Outcomes. There is general agreement in the literature that software development organizational success criteria include two distinct elements: project success and product success (Baccarini, 1999; Ghapanchi et al., 2011). Project success focuses on the successful accomplishment of the project, measured by completing work within the cost, scope and schedule baselines (Aronson et al., 2013; Berssaneti & Carvalho, 2015; Hagen & Park, 2013; Hsu et al., 2011; PMI, 2016); while product success measures the usefulness project's final product as measured by working software (Beck et al., 2001), customer satisfaction (Aronson et al., 2013; Hagen & Park, 2013; Joslin & Müller, 2015; Serrador & Pinto, 2015; Sheffield &

Lemétayer, 2013) and system usage (El Emam & Koru, 2008; Eveleens & Verhoef, 2009; Gemino et al., 2007).

Most measures of success found in literature considered the project aspects of delivering on-cost, scope or schedule resulting in measures of project success, challenges or failures (The Standish Group, 2015, p. 4; Gemino et al., 2007), however, much less literature focuses on success based on the product measures. SAFe® focuses on funding value streams (Scaled Agile Inc., 2020) to support the delivery of software products (versus projects). Table 7 describes approach, level (i.e., Portfolio, Program, Team), source and purpose of data that was collected in this study in support of this research question.

Table 7

Areas of Research - Measurements of Organizational Outcomes

Method	Org. Level	Source	Purpose
Document Reviews	Portfolio, Program and Team	Management Systems – Measures and Metrics	To understand what the organization is tracking as performance metrics and how they report against them.
Observation	Portfolio, Program and Team	Planning meetings, Daily Scrum	To understand how organization goals are prioritized, selected, funded and planned.
Interview	Portfolio	Portfolio Manager, Epic Owners	To discuss organizational and product goals and how they are tracked, measured and managed.
Interview	Program	Program Manager, Release Train Engineer	To discuss program and product goals and how they are tracked, measured and managed.
Interview	Team	Scrum Master, Development Lead	To discuss team goals and how they are tracked, measured and managed.

Appendix B provides the detailed interview questions and a comprehensive plan that integrates all questions by role.

Managing Self-Organized Teams. The self-organizing team structure places ownership and control close to the core of the work, which in turn, increases team responsiveness to change. SAFe® considers self-organization as a core component of lean management. Self-organization is described as a core component within SAFe® at the team level, within the Scrum team; at the Program level within the Agile Release Train; and at the Portfolio Level in the Solution Train (Scaled Agile Inc., 2020). Table 8 describes approach, level (i.e., Portfolio, Program, Team), source and purpose of data that were collected in this study in support of this research question.

Table 8

Areas of Research – Managing Self-Organized Teams

Method	Org. Level	Source	Purpose
Observation	Portfolio, Program and Team	Planning meetings, Daily Scrum	To observe the interactions of the team and the leadership.
Interview	Portfolio	Portfolio Manager, Epic Owners	To discuss how self-organization is used and any advantages and disadvantages of this approach.
Interview	Program	Program Manager, Release Train Engineer	To discuss how self-organization is used and any advantages and disadvantages of this approach.
Interview	Team	Scrum Master, Development Lead	To discuss how self-organization is used and any advantages and disadvantages of this approach.

The questions for this area address the extent of perceived effectiveness of SAFe® on multiple self-organized teams at multiple levels and the perceived benefits or apparent gaps in using this model. Appendix B provides the detailed interview questions and a comprehensive plan that integrates all questions by role.

Managing Non-Linear Relationships. A key competency of SAFe® is that of Agile Product Delivery where the focus of building high-performing teams-of-teams are used to provide a continuous flow of valuable products (Scaled Agile Inc., 2020). The teams-of-teams concept considers both development teams and internal and external customers and other key stakeholders. Table 9 describes approach, level (i.e., Portfolio, Program, Team), source and purpose of data that were collected in this study in support of this research question.

Table 9

Areas of Research – Managing Non-Linear Relationships

Method	Org. Level	Source	Purpose
Document Reviews	All	Stakeholder Registers, Org. Charts	To understand how internal and external stakeholders are engaged.
Observation	Portfolio, Program and Team	Planning meetings, Daily Scrum	To observe how internal and external stakeholders are engaged.
Interview	Portfolio	Portfolio Manager, Epic Owners	To discuss how internal and external stakeholders are engaged.
Interview	Program	Program Manager, Release Train Engineer	To discuss how internal and external stakeholders are engaged.
Interview	Team	Scrum Master, Development Lead	To discuss how internal and external stakeholders are engaged.

The questions for this area are regarding the extent of perceived effectiveness of SAFe® on managing the various stakeholder communities. Appendix B provides the detailed interview questions and a comprehensive plan that integrates all questions by role.

Managing Emergent Requirements. From a software development organization perspective, emergence is realized in emergence of requirements for the software products produced by the organization. Requirements may emerge from organizational goals, customer interactions, product goals, and requirements derived from the architecture and development teams (Scaled Agile, Inc., 2020). Table 10 describes approach, level (i.e., Portfolio, Program, Team), source and purpose of data that were collected in this study in support of this research question.

Table 10

Areas of Research – Managing Non-Linear Relationships

Method	Org. Level	Source	Purpose
Document Reviews	All	Requirements Management System / Backlogs	To understand how requirements are identified, categorized, prioritized and expanded upon.
Observation	Portfolio, Program and Team	Planning meetings, Daily Scrum	To observe how requirements emerge and are managed.
Interview	Portfolio	Portfolio Manager, Epic Owners	To discuss how requirements emerge and are managed.
Interview	Program	Program Manager, Release Train Engineer	To discuss how requirements emerge and are managed.
Interview	Team	Scrum Master, Development Lead	To discuss how requirements emerge and are managed.

The questions for this area address the extent of perceived effectiveness of SAFe® on managing emergent requirements. Appendix B provides the detailed interview questions and a comprehensive plan that integrates all questions by role.

Online Survey Questionnaire

The online survey addresses the fifth research question regarding organizational agility. This section provides a detailed description of the considerations for the survey questions and the resultant instrument is provided in Appendix B.

Measuring Organizational Agility. The CAS concept of responsiveness is considered in the SAFe® core competencies of organizational and team agility. To measure Organizational Agility, a quantitative tool, the "Organizational Agility Profiler Survey" (USC, 2018) was used. Appendix A presents the questions and associated routine used to measure organizational agility for this study. The associated routines (shown in Appendix A) are used to code the responses to the survey based on a 4-point Likert type scale. The coding for each of the four core routines (i.e., Dynamic Strategy, Perceiving, Testing, Implementing) considers equal weight for each question. Question 12 was coded in the inverse where the input was subtracted from 5 to achieve the value for that response. The scores were averaged for each respective routine and a composite Organizational Agility Profile score were calculated based on the average response for each routine. The average score for each organization can be compared against baseline measure provided by the authors (see Table 11).

Table 11

Organizational Agility Profiler Survey Scores(Worley et al., 2014b, p. 36)

Routine	Strategizing	Perceiving	Testing	Implementing
Baseline Threshold	2.75	2.50	2.50	2.70

The table above measures the effectiveness considering various routines of organizational agility that include:

- Strategizing – How top management teams establish an aspirational purpose, develop a widely shared strategy, and manage the climate and commitment to execution.
- Perceiving – The process of broadly, deeply, and continuously monitoring the environment to sense changes and rapidly communicate these perceptions to decision makers, who interpret and formulate appropriate responses.
- Testing – How the organization sets up, runs, and learns from experiments.
- Implementing – How the organization maintains its ability and capacity to implement changes, both incremental and discontinuous, as well as its ability to verify the contribution of execution to performance.

A component score was calculated for each area above and composite score provides for the overall agility. Scores were tallied based on overall, by organization size and by role.

Population and Sample

The population this research generalizes is software development organizations within large businesses in the United States using SAFe® in 2020. A minimum sample size of two software development organizations, from separate businesses, was required for this case study. This study used a random sampling approach by including only U.S. based large business organizations from the Scaled Agile Partner Network. The Scaled Agile Partner Network is comprised of over 350 (Scaled Agile Inc, 2020a) global organizations of various sizes from one-person shops to large business global enterprises (Scaled Agile Inc, 2020d). A minimum requirement of this network is that the partner organization has one or more persons on staff who is a Certified SAFe® Program Consultant (SPC) and has experience in leading the adoption of the Framework (Scaled Agile Inc., 2020d). A minimum sample size of two individual

participants was requested from within the randomly selected organizations: providing portfolio, program and project level information from interviews and either the same or alternate participants for the Business Agility Online Survey. The participants in the online survey may also partake in both the interviews and the survey.

The organizations for this case study were selected based on a set of four criteria. The first criterion is that the organization is a member of the Scaled Agile® Partner Network (described above). This consideration demonstrates the organization's usage of the framework. Second, the organization must be within a large business enterprise. Large businesses, those with annual revenues over $30 million that provide computer programming, systems design, management and other related services (NAICS codes: 541511, 541512, 541513 & 541519), were selected for inclusion in this study (U.S. Small Business Administration, 2019) due to the business drivers of those moving to large scale agile methods (e.g., larger team size, geographical distribution, regulatory compliance, organizational distribution, technical complexity, domain complexity, organizational complexity, and enterprise discipline [Ambler, 2010]). Third, the selected organization has its primary presence in the United States of America. This reduces legal concerns, limit cultural influences and differences and provides this researcher greater access for interviews. The final criterion is that the researcher works for a large accounting and audit firm and the selected organization cannot be an audit client of this firm due to the US Securities and Exchange Commission's restrictions on organizational independence. Table 12 presents the resultant sub-population of 40 potential study participant organizations.

Table 12

Potential Study Population Based on Selection Criteria

Description	Count	Comments
Total Scaled Agile Partners	383	As of June 1, 2020

Description	Count	Comments
U.S. Based Scaled Agile Partners	202	Removed Non-US based partners
Large Business Partners	59	Removed small businesses
Unrestricted Organizations	40	Resulting sub-population

In order to facilitate random selection, based on the criteria above, the researcher listed the resulting organizations from the Scaled Agile Partner Network into a spreadsheet alphabetically. Then using a random number generator, a number was assigned to associate a normally distributed random number with each remaining member of the participant pool. The alphabetical list was then be sequenced by the random number assigned by the software algorithm. Potential participants were then contacted and requested to participate in this study based on this new random sequence.

This researcher leveraged SAFe® and social media networks to engage the randomly selected potential participant population. As a SAFe® credential holder this researcher has access to the Scaled Agile Community. The Scaled Agile Community includes over 450,000 SAFe® trained professionals in over 110 countries and an online forum on of over 97,000 SAFe® certified professionals (Scaled Agile Inc., 2020e), and access to the Scaled Agile Partner Network, a community of over 350 businesses (Scaled Agile Inc., 2020a). This researcher also belongs to multiple agile and large-scale agile LinkedIn groups and has a personal and professional network of over 800 LinkedIn connections.

Procedure for Data Collection

Once participant organizations were selected and approved by the Dissertation Committee, the researcher sent an email to a contact within the organization seeking participation and an initial meeting. For each organization a minimum of two interviews were requested with participants that have insights into the use of SAFe® at the portfolio, program

and team levels. Several topics were discussed during this meeting that include: research goals, confidentiality (Also if an NDA if required), ability to publish aggregated findings, timelines, access requirements, a review of area of data collection (i.e., document reviews, interviews, observations), the duration of the study (2-3 weeks depending upon schedules), expected outcomes, access to findings and the specific areas of interactions for data collection that include:

- Portfolio Level Interactions for Data Collection: Interviews with at least one professional (or the Program Level if the Organization is using essential SAFe®) at this level (e.g., Customers, Epic Owners, Enterprise Architect, Portfolio Manager). Permission to view systems and documents related to the interviews.
- Program Level Interactions for Data Collection: Interviews with at least one professional that has insights and access to SAFe® practices used at this level (e.g., Product Managers, System Architect/Engineers, Business Owners, Program Manager / Release Train Engineer, PMO Analyst). Permission to view systems and documents related to the interviews.
- Team Level Interactions for Data Collection: Interviews with at least one professional that has insights and access to SAFe® practices used at this level (e.g., Product Owners, Scrum Master, Development Lead, Business Analyst). Permission to view systems and documents related to the interviews.
- Cross Team Interactions for the Online Survey: The organization was requested to have at least six members of the software development organization participate in the Business Agility Online Survey. The survey captures the area where the participant

primarily contributes (i.e., Portfolio, Program or Team) for comparison purposes. The interview participants may have also partaken in the online survey.

Appendices A and B include additional detail on specific observations, artifacts and questions that support the data collection.

Quantitative Data Collection Technique

The data collection approach selected for the quantitative portion of this research was to use a survey instrument, specifically a questionnaire. “Survey research provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population” (Creswell, 2014, p. 13). A survey is used to test theories by providing an unbiased view using closed end questions and presenting the resulting data using statistical procedures.

The data were collected using Qualtrics Software’s online survey tool. The survey is provided in Appendix A. Once the survey data was collected, the “Organizational Agility Profiler Survey” guidance was used to score and compare the results.

Qualitative Data Collection Technique

The interviews were conducted using Skype. Skype provides the researcher with several options for meeting with the participant; the researcher may call the participant directly from Skype or the participant can join either via a computer or dial in to the phone number to join the call. Skype also provides the ability to record the interview, if approved by the participant, or share real time notes and interview questions via the conference call software. Skype also has a tool to transcribe the conversation into a written format. A sample of the interview questions is provided in Appendix B. Once the data from the study was collected, the responses were coded, via notes the researcher collected during the interactions. A summary of the findings is presented in the Findings Section of this document.

Reliability and Validity (Quantitative)

Reliability refers to the "extent to which people in comparable situations will answer questions in a similar way" (Fowler, 2014). For an instrument to be considered reliable, it must be "internally consistent (i.e., are the item responses consistent across constructs?), stable over time (test-retest correlations) and consistent in their test administration and scoring" (Creswell, 2014, p. 247).

The "Organizational Agility Profiler Survey" instrument (Worley et al., 2014b) can be considered reliable as it has consistently achieved a Cronbach Alpha coefficient of greater than 0.80 in studies of 243 large firms in 17 industries over the 30-year period from 1979 to 2009 (Worley et al., 2014a). Organizational agility studies using this instrument from Mirinezhad et al. (2014) and Gagel (2018) reported Cronbach Alpha coefficients of 0.89 and 0.96, respectively. Najrani (2016) published the reliability coefficient for each of the 15 questions they used from the survey and reported an average coefficient value of 0.84. Young (2013) published the reliability coefficient for each group of questions and reported the average value of 0.87. Chermack, Lindsey, Grant and Barber's (2019) study reported an overall Cronbach coefficient of 0.88. Considering the Cronbach scores was already calculated in many prior studies, this study considers the instrument to be reliable.

Triangulation (Qualitative)

For the qualitative portion of this study, the interview questions were reviewed with an expert panel of three highly experienced professionals prior to conducing the interviews. All reviewers have over 20 years' experience in software development organizations and each hold master's degrees and multiple certifications in project management and software development methods. In additional, all three reviewers have certifications in Scrum (the underlying method

in SAFe®) and two hold the advanced Certified SAFe® Program Consultant (SPC) credential. This researcher also holds two SAFe® certifications (i.e., SA, LPM) in addition to Portfolio, Program and Project Management Professional certifications. Following the review with each expert, the questions were updated and are presented in Appendix A.

Reliability is accommodated by triangulating the responses with another method of data collection. This included corroboration from: the quantitative survey, observations in meetings, document reviews, and multiple interviews at the same organization. The findings for each case are presented based on a confirmation of a primary finding from at least one second source validating the information within the same organization.

Data Analysis

Quantitative data was analyzed directly from the survey responses. The survey began with an overview, requiring the participant to opt in or out. The initial set of questions presented elicit responses regarding organization agility use a 4-point Likert-type scale. The second group of questions request demographic information regarding the role of the respondent (Portfolio, Program or Team level). Once all data were collected, descriptive statistics were used to analyze the data. Descriptive statistics included mean scores and profile was derived by using the techniques in the Organizational Agility Profiler Survey. Multiple charts provide a view to demonstrate the mean differences for each of the organizational responses.

Qualitative data analysis was performed by coding the responses and using descriptive statistics to represent the findings in the interviews. This information was compared against the quantitative data to assess if patterns emerge between the two data sets for each organization.

The findings from each individual case study are presented. Finally findings from each case study was compared and findings regarding commonalities and difference are documented. Study conclusions were drawn from both the individual studies and this cross-case information.

Researcher's Perspective

This researcher holds a post-positivist world view. According to Creswell (2014), Post-positivists hold a deterministic philosophy in which causes (probably) determine effects or outcomes. Considering the theoretical framework for this study, the researcher is cognizant of his worldview and made all efforts to ensure this does not influence the research outcome.

Anticipated Ethical Issues in the Study.

Ethical issues can be encountered at all phases of research. This section describes the types of issues, timing and mitigation strategies. All efforts were made to recognize and eradicate personal bias from the development of the instruments and resultant findings. Ethical issues can be introduced at three distinct milestones that include: prior, during, and after the study. This researcher made every practical effort to recognize and reduce the probability of encountering these issues through a comprehensive review of all materials produced and the process used to gather information. This review is also supported by oversight from the dissertation committee at each of these milestones.

Prior to conducting the study

This researcher took the requisite training for Human Subjects research. Upon completion of the draft of the interview questions and survey instrument, and based on committee member consultation, this researcher presented the study to the University's Institutional Review Board (IRB) and received approval prior to administering the survey or conducting interviews.

During the study

The purpose of the study was provided with the survey and interview questions, so the participants understand how the information will be used. This may impact the number of surveys completed as some potential participants may opt out for various reasons. Regardless, the purpose was be presented. All care was taken to focus the research questions on only that information required to meet the research goals. Efforts were taken to minimize the number of research questions to reduce the amount of time required form each participant. All efforts were taken to protect the privacy and anonymity of participants.

After the study

Appropriate efforts were taken to analyze the data objectively. Given the nature of quantitative analysis, this researcher let the numbers speak for themselves and act to reduce personal bias. For the interview coding, all efforts were taken to minimize the introduction of bias. In the dissertation document, only primary research was used, and the document was analyzed with a plagiarism utility to identify and rectify any issues. All ownership of models, tools, text, data or any other considerations were cited with the original author.

CHAPTER 4

RESEARCH FINDINGS

The purpose of this mixed methods study was to examine the extent of perceived effectiveness of the Scaled Agile Framework® in software development organizations using Complex Adaptive Systems as a lens to guide the study. As discussed earlier, organizational effectiveness considers the efficiency with which an organization fulfils its objectives without placing undue strain on its members and / or society (Georgopoulos & Tannenbaum, 1957; Manzoor, 2011; Thibodeaux & Favilla, 1996).

Based on the selection criteria presented earlier, 40 companies were considered for this study. A total of three (7.5%) organizations chose to participate in this study. The participants included US-based software development organizations within the following industries: Retail, Government, and Logistics. All efforts were taken to protect the confidentiality of the study participants and their associated organizations. The organizations will therefore be referenced only by their industry throughout the remainder of this document. The individuals are only referenced by their SAFe® role (e.g., Product Owner) or their title (e.g., IT Director).

This exploratory case study is guided by one primary and five supporting research questions presented below:

- RQ1: What is the extent of perceived effectiveness of the Scaled Agile Framework® in software development organizations using Complex Adaptive Systems as a lens to guide the study?
    - RQ1a: How and to what overall perceived effect are software development organizations using SAFe® to measure organizational outcomes?
    - RQ1b: How and to what overall perceived effect are software development organizations using SAFe® to manage self-organization/self-organized teams?
    - RQ1c: How and to what overall perceived effect are software development organizations using SAFe® to manage non-linear relationships?
    - RQ1d: How and to what overall perceived effect are software development organizations using SAFe® to manage emergent requirements?
    - RQ1e: How and to what overall perceived effect are software development organizations using SAFe® to support organizational agility?

Instrument Administration

Organizations were recruited based on the selection criteria presented in the Methods section of this document. The data were then collected from September 1, 2020 through December 15, 2020. To answer research questions “RQ1a” through “RQ1d”, individual interviews were conducted across the organizations. The initial interviews ranged in duration between 45 and 60 minutes. Some follow up meetings were held, and emails were sent to clarify information gathered during the interviews and for additional observations. To answer “RQ1e” regarding organizational agility, links to online surveys were shared with the participating companies.

Following initial contact, the researcher requested email addresses and contacted potential participants directly. Only one initial and one follow up email was sent to prospective participants. Where there was either a dissenting or no reply (after the second try), no further contact was initiated. The online survey was administered anonymously, and snowball sampling responses were possible; therefore, it is not possible to know which participants responded to the survey. Since the interview participants were also invited to complete the questionnaire, and it was anonymously administered, it is not possible to know who took part in both data collection activities (i.e., the interview and online survey). Finally, a separate questionnaire was developed for each organization and each was given a unique URL to access questionnaires. This allowed for findings from the online surveys to be based on each organization and in aggregate.

The researcher had initially intended to only send recruiting emails to five organizations at a time to achieve a minimum of two participant organizations. Due to the low rate of those that agreed to participate, ultimately all 40 potential participant organizations were contacted during the recruiting period to achieve the requisite number of participants (i.e., minimum of two companies). Table 13 presents the overall response rate.

Table 13

Response Rate

Organization	Count	Percent of Total
Sample Population	40	100%
Email Requests Submitted	40	100%
Total Respondents	18	45%
Responded but not participating	13	32.5%
Agreed to Participate	5	12.5%
Fully Participated	3	7.5%

Of the organizations that responded but chose not to participate, various reasons were given including the organization: was not able to take the time participate; is not using the method internally but using for clients; was just starting to use SAFe®; had legal concerns; had intellectual capital concerns; could not participate due to client contract terms; and had concerns regarding the researcher's employer is a competitor organization. For the two (of the five) organizations that initially agreed to participate, an initial interview was held with each organization, however neither responded to two follow-up emails. Ultimately, three organizations participated in the study.

The Indiana State University Institutional Review Board (IRB) approved the study on September 1, 2020. This approval included an approved consent form for the interview participants and one for anonymous respondents to the on-line survey. The informed consent for the "in person" qualitative portion of the study was presented and collected from each study participant. The online survey participants were required to agree to the terms of their participation before taking the on-line survey. If they chose not to agree, the on-line survey was not presented, and the survey tool brought them to a "thank you" page.

Summary of Participant Profiles

Participant profile information was requested in the interviews and on the online surveys. In both the interviews and surveys, questions were presented regarding organizational level (Portfolio, Program or Team). For the qualitative portion of the study, there were a total of nine participants – three from each organization. A total of 18 survey responses were received, however, only 11 were usable, therefore information regarding only the usable surveys is provided. Table 14 presents the organization level reported for all participants.

Table 14

Number of Responses by Organizational Level

Participants	Portfolio	Program	Team
Interview Participants	4	2	3
Survey Participants	2	4	5

All interview participants held at least one SAFe® certification, many held multiple certifications. Table 15 provides the certifications the interviewees reported. SAFe® certifications were not requested in the on-line surveys.

Table 15

Interview Participant SAFe® Certifications

SAFe® Certification	Abbreviation	Count
Certified SAFe® Lean Portfolio Manager	LPM	2
Certified SAFe® Government Practitioner	SGP	1
Certified SAFe® DevOps Practitioner	SDC	2
Certified SAFe® Program Consultant	SPC	4
Certified SAFe® Release Train Engineer	RTE	5
Certified SAFe® Product Owner / Product Manager	POPM	4
Certified SAFe® Advanced Scrum Master	SASM	4
Certified SAFe® Scrum Master	SSM	5
Certified SAFe® Practitioner	SP	1
Certified SAFe® Agilist	SA	8

Case Study 1 – A Retail Organization

The retail organization that participated in this study is a multi-billion-dollar business and is among the National Retail Federation's Top 100 US retailers in 2020. The rankings are assigned based on annual revenue for retail sales (excluding non-retail) in the United States.

This organization transitioned from using a Waterfall approach to SAFe® circa 2014. They started their transformation with the support of the integrator, using the "Essential" configuration of SAFe® (i.e., Program and Team level). The team began by defining a single "value stream" (i.e., all steps to bring a specific product or service to a customer [e.g., Order to Cash]) to focus and organize their work. They then created a 10-week Product Increment (PI) roadmap and established an Agile Release Train (ART) for business and technical resources to collaborate to define, prioritize and incrementally develop and deliver new software solutions.

After the first few Program Increments, and as additional value streams were introduced, the organization found the need to better align organizational strategies. To achieve this goal, they adopted SAFe® Portfolio Management practices. At that time, SAFe® portfolio management practices were still emerging. SAFe® Portfolio Management practices grew over the years and in January 2020, SAFe® released version 5.0. This new version placed a significant focus on practices at the portfolio level. The retail organization is now using the "Portfolio configuration" of SAFe® 5.0 and funding work by value streams, that is, they use "economic guardrails." Strategic Themes are documented to guide and align the business and technology organizations.

Today, backlogs are in place at the portfolio, program and team levels for transparency of work-in-process (WIP) and 2 Agile Release Trains (ARTs) are currently active. Using SAFe® the team was able to move from 3-4 annual release cycles (using Waterfall) to 24-27 annual releases.

Interviewee Profiles

The interviewees included a Lead Agile Coach and two Senior Scrum Masters; all of whom helped transition the organization to SAFe®. All interviewees hold multiple SAFe®

certifications. In addition, each interviewee has earned either Agile and/or Project Management certifications. The average number of years of SAFe® experience amongst the three respondents is greater than 6 years.

RQ1a: Organizational Outcomes Findings

The interview questions related to the first research question requested information about the perceived effectiveness of SAFe® on organizational outcomes. Questions in this area included the business drivers for selecting SAFe®, trends in performance since the transition to SAFe® and the perceived effectiveness of SAFe® practices for strategic alignment. The participants were also asked to share their perception of the benefits realized through efficiencies gained or outcomes improved. They were also requested to share any challenges they perceived while implementing SAFe® or those that remained afterward.

When presented questions regarding the business drivers or "reasons why" the organization transitioned to SAFe® two cited the primary driver as a "need to quickly provide our customers with digital commerce." Another interviewee stated: "we were struggling to deliver what was asked of us without the structure or process to get there [using Waterfall]" and we "just simply needed to go faster." Two described a major problem was that "the software baseline had significant technical debt" impacting their ability to achieve their new "digital commerce strategy." They described the technical debt as a condition where the developers were making quick changes to the code to meet the immediate needs of the business without applying code standards or updating the underlying architecture. This condition resulted in a significant amount of effort (debt) needed extend the current system to support new customer requirements.

Throughout the interviews and subsequent discussions, themes emerged regarding their current method (Waterfall), in that in their experience it lacked the ability to provide the "speed",

“prioritization”, “transparency” and “code quality” needed to respond to their customer’s emerging needs. Using SAFe® one participants stated that “the organization went from delivering 3 to 4 releases a year to delivering ‘incremental value’ with fewer bugs and less rework 24 to 27 times a year.” In addition, two stated that the “customer feedback cycles were faster” and their “relationship with their business customers became stronger.”

Performance measurement was then discussed. Using the Waterfall method, one of the Scrum Masters stated that “there were No KPIs to speak of” and the development team “often delivered late” on new features because “they spent a great amount of time changing the current system to deliver the new features” because of the “technical debt.” Another Scrum Master said the “biggest challenge was consistency in what they delivered,” and they echoed the concern about “late delivery.” All three interviewees said with the introduction SAFe® and Agile approaches they were using “Story Points” to measure “Velocity” as a primary measure of performance. The team uses “Burnup charts” to measure velocity (throughput) and to determine if additional scope was introduced in an iteration. Additional measures of performance include “Customer experience” scores as “leading indicators based on measuring system performance and customer feedback.” “System performance” is measured using end user system response time and customer feedback was elicited via customer meetings and periodic end user surveys.

The interviewees shared the SAFe® practices providing the greatest benefits were those that focused on “strategic alignment”, “transparency”, “customer collaboration” and “prioritization.” The following practices were noted as very effective in achieving their goals and included: Strategic Themes, Program Increment Planning, Product Owner Sync, Program Backlog Refinement and ART Sync. Strategic alignment and prioritization at the top levels were enabled through the development of Strategic Themes and prioritization through Program

Increment Planning. The Lead Coach went on to describe the value of strategic themes by saying it was an opportunity “to gain an agreement with management on the priorities” by “focusing on business value.” One of the benefits of having the organization come together for these prioritization and planning workshops was the team was able to “refine the program backlog” to better understand the “intent” of the new features being requested which would reduce rework later in the cycle. One Scrum Master noted a major benefit in transitioning to SAFe® was in the reduction of time for signoffs, both for “initial funding” and later for “acceptance” of the completed work. Signoffs would take “several weeks or even months,” inhibiting the ability to deliver quickly. Using SAFe® today, the team receives signoff as part of the process and the delays are eradicated or “minimal.”

Despite the benefits described above, there were some notable challenges. When asked about the challenges, two of the participants discussed the difficulty in “getting the right people in the room” for the meetings. When asked what is meant by the “right people,” they responded that some of the people who were delegated to attend lacked either the “knowledge” to help refine new features or did not have the authority for decision-making regarding priorities. They went on to say, “in some cases, no one would attend [the meetings]” to represent the “voice of the customer.” When this occurred, follow up meetings and emails were required. One noted that considering the new approach is based on two-week iterations, “time critical” decisions are required to maintain the “cadence.”

One Scrum Master noted a challenge in that Program Increment (PI) planning “is good but only includes the next 12 weeks” and “there is a gap in not having a long-term roadmap.” Others interviewed said that they assemble and maintain three PIs at a time. It was not clear

whether the first participant, or their customer, was looking for something longer than nine months out, or if that they were unaware that PI planning included the current and next two PIs.

A final concern was that the funding was "aligned with teams and not value streams." This created a situation where the priority was with one team, however, the budget was not available for them to meet that priority. A researcher's observation in this area is that while SAFe® includes a practice for Participatory Budgeting in the Portfolio configuration, based on this finding it appears they are not using this practice.

RQ1b: Self-Organization Findings

Supporting questions included the perceived effectiveness related to the use of self-organized teams and the benefits and challenges in this area. The interview participants shared that this organization is using self-organizing practices primarily at the team level. When asked about the use of self-organization at the Portfolio and Program level, the team described it as "not so much", "not really using it" and "less [used] than with the teams." At the team level, as teams matured some were able to "select their own work" and one interviewee responded that "most [team members] did well" under this arrangement.

The Lead Coach provided an additional comment on self-organization in that "it is a trust process." All cited the perceived benefits achieved at the team level included "high morale" and "faster delivery" based on "having people choose the work in which they are most comfortable."

While self-organization is a core component of SAFe®, it appears management did not fully embrace this arrangement. One participant cited a lack of "business support early on" for self-managed teams. This is also evidenced by two respondents noting challenges that "teams need time to build trust," and "it is not helpful [for management] to continually change out team members" in that it "impacted the flow of delivery." While the participants perceived self-

organization was occurring at the team level, the challenges noted may serve as evidence against this practice being universally applied.

RQ1c: Non-Linear Relationships Findings

Participants were queried on their perception of the effectiveness of SAFe® practices in engaging stakeholders at all levels. The participants were also requested to discuss perceived benefits or challenges in this area.

This organization uses several SAFe® practices to enhance collaboration and communications amongst internal organizational units and to represent the needs of their customers. The interviewees described their use of the ART Sync, PI Planning and Program Backlog Refinement practices, to enable business and IT organizations collaborate. With these practices in place, one interviewee said they were able "to deliver what customers really want" versus "management's perception of customer's needs."

The Product Owner was cited as a "key player" to maintain the "voice of the customer" by managing the priorities throughout the delivery cycle. The PO participates in multiple collaborative sessions including the Portfolio Sync, ART Sync and Portfolio Backlog Refinement sessions. Two participants shared that the organization also uses customer interviews, prototypes, "canary releases [where several options are presented]" to elicit requirements and demonstrations at the end of the development cycle to share the new functionality that was now available. The benefits noted of early customer interaction includes "having direct customer input before development" drives "faster decision making," "more accurate decisions," and "improved team morale by understanding customer expectations" which results in increased customer satisfaction.

Participants also noted that the Product Owner must only have one role and cannot also be the Product Manager. “When the Product Owner is also the Product Manager, this will cause conflicts” one participant said. If a person has both roles, a dual agency situation would arise resulting in conflicting goals between business prioritization and speed of delivery. One participant described this as a conflict between choosing the highest priority work with the “greatest business value instead of the work that was easiest to complete.”

Another challenge noted was to ensure stakeholders understand the difference between prototypes where requirements are elicited and demos which were often “misconstrued as an opportunity to add features” versus “showcasing the work [completed].” A previously stated challenge also described in this area is to gain the active involvement of the “right” stakeholders; those who know the business well enough to understand the organizational strategy and impacts of decisions relative to prioritization and implementation of those strategies.

RQ1d: Managing Emergence Findings

Emergence is realized through requirements for new features provided by the software. Questions regarding the perceived effectiveness of SAFe® practices in the management and prioritization of software requirements, handling of emerging and emergency changes were discussed. The challenges and benefits were also requested.

In the interviews the participants described several sources of high priority needs for new features including: “marketing promotions,” “security patches,” “regulatory requirements,” “tax code changes,” and “legal compliance.” When asked about the benefits of SAFe® in this area, one interviewee described SAFe® practices as allowing for multiple “pivot points where you can accept change” within the “built in contingency.”

All three participants stated that this organization allocates some capacity within each PI cycle to accommodate critical changes. Two participants noted that "mid-sprint (iteration) changes are not allowed unless absolutely business critical." If there is an "urgent change" the team conducts an analysis using "quantitative, qualitative and business value measures." If then the "urgent" or "emergency" change results in a higher priority than the currently scheduled work based on this analysis, it will be added at the next opportunity. One participant stated that this approach "takes the emotion out of decision making" and "forces the business case" for the change.

The interviewees also noted that for mid-sprint "urgent" changes, the Product Owner is a key decision maker in assessing the risks and downstream impacts of the "tradeoffs that would have to be made" to accommodate the unplanned work. The team would prepare a "quantitative and qualitative impact statement" on business value of potential tradeoffs to aid in this decision. Two participants cautioned that the "emergency" changes cannot become commonplace as they would erode the foundational concepts of "planning" and "prioritization."

Overall Perceived Effectiveness Findings

At the end of each interview, summary questions were asked regarding their overall perception of the effectiveness of SAFe®. Questions were presented in regard to efficiencies gained, challenges that remained and final questions regarding anything unexpected that they found when transitioning to SAFe® and their overall perception of its effectiveness.

In terms of overall efficiency gains, one participant described a benefit at the team level. SAFe® "allows for better cadence and throughput" by getting "good in and better out." Another described a benefit of prioritization with the business and the ultimate hand off to development teams "within sprints today the team's work is packaged and ready for them" and now "they [the

teams] say how and not what [work] is done." A third participant noted that with the new process teams and management, "have confidence in our ability to deliver."

When asked about the challenges in using SAFe®, most noted the need for change management and strategies for interactions with and dependencies on outside teams. This is evidenced by one interviewee saying that "management needs to embrace trust, autonomy and decentralize control to allow decision making at all levels" for the process to work properly. Another said that "change management was needed at all levels" to reduce the amount of "push back" and "power plays." This participant also noted a "lack of customer engagement on some teams" is inhibiting that team's ability to keep the "cadence" of other teams.

Two participants cited challenges in working with "non-SAFe®" dependent organizations. "They [infrastructure teams] have less flexibility due to manufacturing dates" to deliver hardware and infrastructure services impacting our "ability to align schedules." Another challenge with dependent organizations was that "it took a lot to get the strategy included [in our work]" and when "they [organizations they are dependent upon] don't manage top/down" it is difficult to "align on strategy."

When asked about anything that was unexpected during the transition to SAFe® or today, a variety of topics were raised. One was "pleasantly surprised how engaged [business] teams were" and were pleased to see "IT and business leaders collaborate." Another participant shared a similar finding in that "people were very bought into the process and happy to move forward," however, "for an executive to say 'yes' [to participating] and then revert for no provided reason" was disappointing.

Two of the participants discussed changes in the SAFe® framework over this period of time. One said SAFe® has "matured from a method early on to a framework today" with

"suggested verses required" practices. And SAFe® has "become more self-aware" of their impact and usage "in the field." One lauded the introduction of "core values and principles" into the SAFe® framework.

When asked if they perceive SAFe® as an effective framework, a unanimous "yes" was provided. One said: "teams are generally happier" and "they couldn't imagine going back to the old way," "some [team members] said they would have to leave." Another participant stated that SAFe® provides us with "faster delivery and customer centricity" that we needed. One of the participants provided a caution that the transition "must be supported by leadership" in order to "take hold." This was consistent with prior statements regarding the need for change management.

The quantitative portion of this study, regarding RQ1e: Organizational Agility, is covered separately after the summary of qualitative findings section.

Case Study 2 – A Government Organization

The government organization that participated in this study is a large organization with over 4,000 employees. The software development organization currently using SAFe® has approximately 50 team members organized as a single Agile Release Train with five sprint teams consisting of between 7-10 people per team.

This organization started their transformation in late 2019, with the support of a systems integrator, using the "Essential" configuration of SAFe® (i.e., Program and Team level). While they are using some portfolio practices, considering the relatively new adoption of SAFe®, the organization is trying to "prove out" the value with the Essential configuration before fully introducing new governance and controls at the Portfolio level. The team started by creating a 12-week Product Increment (PI) roadmap and established an Agile Release Train (ART) for

business and technical resources to collaborate to define, prioritize and incrementally develop and deliver new software solutions. While SAFe® suggests 8-12-week PI roadmaps, this organization chose 12-week PIs to align with the quarterly reporting requirements of this government organization.

Interviewee Profiles

The study participants included a Program Manager and two Scrum Masters. All three have been with this organization from the beginning of their SAFe® journey. All interviewees hold multiple SAFe® certifications. In addition, each interviewee has earned at least one additional Agile certification. The average number of years of SAFe® experience amongst the three respondents is just over two years.

RQ1a: Organizational Outcomes

The interview questions related to the first research question requested information about the perceived effectiveness of SAFe® on organizational outcomes. Questions in this area included the business drivers for selecting SAFe®, trends in performance since the transition to SAFe® and the perceived effectiveness of SAFe® practices for strategic alignment. The participants were also asked to share their perception of the benefits realized through efficiencies gained or outcomes improved and to share any challenges they perceived while implementing or challenges that remained afterwards.

The primary organizational drivers for selecting SAFe® included a desire to “increase the speed of delivery,” “coordinate multiple overlaps [interdependent teams],” “improve product quality” and “eliminate waste in the development cycle.” While one participant noted that software bugs will still occur with SAFe®, they said the process to “adapt to defects moves quicker and smother.” They added that the cascading effect of “defect on defect” found in

Waterfall was reduced significantly (using SAFe®) because a smaller portion of the software baseline is now developed and delivered at one time. Using SAFe®, the team began Program Increment planning in 12-week increments (i.e., 6 – 2-week sprints) to align with the government organization's quarterly planning cycle. Although software is now available to be released after each two-week iteration, due to the legacy operational turnover requirements taking four weeks for each release, the software is currently deployed twice a quarter (versus quarterly).

Using the Waterfall method, there was "little visibility and coordination among teams." One participant reported that this "caused significant issues" at the time to integrate software "months later." Prior to using SAFe®, requirements were developed and interpreted differently by each team working on the software. When it came time to integrate the outcome of the teams, "there were misalignments." Using SAFe®, the team developed Program Increment Plans to sequence the development activities based on "customer priorities." PI planning is helping the teams identify and coordinate the timing of their dependencies on other non-SAFe® teams.

When asked how performance is being measured using SAFe®, all three stated that "Velocity" was introduced as a common KPI to measure the output of the scrum teams. Because the organization is in transition to SAFe®, some Waterfall artifacts are still required from the customer. While not a best practice of SAFe®, "Gantt Charts" are prepared to show the customer the intended and achieved progress in a format in which they are familiar. Despite having to use some hybrid methods for reporting (one team member used the term "WaterSAFefall" to describe this condition) the team is primarily using SAFe® practices to track and mange work. This includes a Burnup chart where teams can demonstrate their completion rate (versus amount remaining) and they track if additional scope was introduced after planning the Program Increment or Sprint planning cycles. In a very short time, the team stated they were able to

demonstrate progress with the new framework (i.e., SAFe®) by using [product name redacted] tools that allow “visibility for customers” on “work in progress and completion rates.” One stated the visual dashboards “allowed for better communication with the client.” The team also said after the first few 2-week iterations they were able to “complete on trend” with their projections and “velocity improved” overtime.

The SAFe® practices the interviewees cited as the most effective included: Program Increment Planning, Scrum of Scrums, and the Scrum daily standup meeting. The most often cited benefits included “transparency” and “visibility” by using dashboards to make progress visible based on their customer’s needs. Another benefit cited was “being able to make data driven decisions” based on processes used to “calculate effort” and “demonstrate business value.”

Considering the team has been using this method for just over one year and only a portion of the overall software development organization is using SAFe® some challenges were noted. When asked about the challenges, one participant stated “there is a big hurdle in changing clients’ mindsets” when moving to a new process. “Governance,” “management reporting structures” and “progress reports” and “methods for contracting for software development services” were cited as concerns amongst the study participants. In this case with a Government organization, many “institutionalized rules and processes” needed to be considered and addressed. As an example, “contracts are not setup for Agile or SAFe®.” The “current contracts define specific deliverables” that are “different from those in SAFe®.” From a reporting perspective, SAFe® provides data driven reporting based on actual work complete. Using Waterfall, this organization uses “Earned Value Management” to measure the “value” of work in progress. Earned value fluctuates based on variations of cost and time expended due to the long

timeframes for delivery, whereas SAFe® focused on the delivery of "working software." During the initial stage of this effort, "hybrid [WaterSAFefall] reports" have been automated to bridge the Waterfall and SAFe® methods.

RQ1b: Self-Organization

Participants we requested to share their perception of SAFe's® effectiveness related to the use of self-organized teams. They were also requested to describe the benefits achieved and challenges encountered or those challenges that remained.

The interview participants stated this organization is using self-organizing practices primarily at the team level. Two interviewees responded that the organization was using self-organization "most of the time" while one quantified the usage as "75% of the time." The respondents noted that considering where they are with the journey, the goal of self-organization at all levels is a future initiative. The benefits cited of self-organization included providing the teams "more agency" to choose their own work which "slightly improved team morale." The challenges were described as "it starts with the customer" meaning if they support this practice, it is used, however, some customers are using the legacy management styles and have not yet embraced the new practice.

RQ1c: Non-Linear Relationships

Participants were queried on their perception of the effectiveness of SAFe® practices in engaging stakeholders at all levels. The participants were also requested to discuss perceived benefits or challenges in this area.

This organization uses several SAFe® practices that enhance collaboration and communications with key stakeholders. This organization uses Program Increment Planning to align and define the focus of the next 12-weeks of activity. This foundational plan sets the work

performed within the “value streams.” Other key practices in this area include the Product Owner Sync, Portfolio Backlog Refinement, ART Sync [with the customers], Scrum of Scrums [with the team only] and “demos” [with all stakeholders] at the end of the cycle to share the outcome of an iteration. The Scrum of Scrums (SoS) is used to connect the teams and ensure that the software output from each team integrates with the output of the other teams. They also use the SoS to “work through issues before bringing options to customers.” Finally, at the team level, “daily standups” (usually in a 15-minute time box) are used to align the work of each team independently.

The Product Owner plays a critical role in representing the customer needs and setting the business priorities. They participate in multiple collaborative sessions including the Portfolio Sync, ART Sync and Portfolio Backlog Refinement sessions. Product Owners (POs) are assigned to each value stream. In this case, a challenge was noted in concurrently balancing “client education” as they assimilate the new method while maintaining “deference” to their position as the customer and decision maker. Program Backlog Refinement was described as a major benefit where the clients and the business analysts, representing the development team, come together to “refine” the requirements to ensure the product delivered will meet the business need. This organization also uses Sprint kick off meetings to share their plans for the next iteration; prototypes or “mock ups” to facilitate discussions with the PO on alternatives early in the process; and demonstrations (demos) of the new functionality once developed.

Considering the team was concurrently working to implement the new process and train the client, they experienced unique challenges. On the outset one participant noted “push back” from some and a desire to revert to the former process (Waterfall). The interviewees noted that they had to provide “training on both Agile and SAFe®” and there was a significant “learning

curve on both the processes and tools used to track progress." The participants also noted that the clients were used to planning for longer term releases and "wanted to do more in each iteration." Early on they spent a great amount of time "managing expectations." One participant encapsulated this in their statement that "we only have so much capacity" in a two-week iteration. One did note that "it is getting better" as the customers become more experienced in the new process.

RQ1d: Managing Emergence

Emergence is realized through requirements for new features provided by the software. Questions regarding the perceived effectiveness of SAFe® practices in the management and prioritization of software requirements, handling of emerging and emergency changes were discussed. The challenges and benefits were also requested.

In the interviews the participants described sources of high priority changes came primarily from the existing backlog and emerged from responses to operations "break-fix" and "regulatory changes." One participant noted a benefit of using SAFe® was having a "prioritized backlog" of work and a Product Owner responsible for making the decisions related to that priority. Another interviewee noted two additional benefits in that since "a few teams are [now] working off the same backlog, the work can be spread over multiple teams" for high priority changes, reducing the burden on a single team. A challenge included changes that come with "a pre-prescribed deadline" due to legal compliance. However, this same interviewee noted that using "data driven decision making" they were able to determine the appropriate "tradeoffs" to meet the new requirements.

Overall Perceived Effectiveness Findings

At the end of each interview, summary questions were asked regarding their overall perception of the effectiveness of SAFe®. Questions were presented related to efficiencies gained, challenges that remained and final questions regarding anything unexpected that they found when transitioning to SAFe® and their overall perception of its effectiveness.

One participant stated the greatest gains in overall efficiency came from the "transparency of work-in-progress" using SAFe®. By using a "single source of truth" (i.e., a centralized management tool) across multiple teams, the team is able to "report dynamically" and provide the client a "big picture" of the progress in "real time" versus using weekly reports. "Having the data to drive decision making" was described as a major benefit of using a single management tool.

The participants noted several challenges. One said it was difficult to get "full buy in" and another said adoption was slow because in some cases it's "hard to teach an old dog new tricks." Another participant noted that the "organization is ingrained in certain methods," referring to management controls that are based on the Waterfall method. An insight from one participant was that the integration was especially difficult because neither "the client or contractors had much experience with SAFe®" prior to the transition. While training was provided, "integration [of SAFe®] is difficult" because of the need for "organizational change management." Another challenge is "it is difficult to align schedules" with "others not using SAFe®." In this case they were speaking about the infrastructure team.

When asked if they perceive SAFe® as an effective framework, a unanimous "yes" was provided. One said "yes, absolutely" and went on to say they were "pleasantly surprised they [the client] were able to see value so quickly" with the new process.

Case Study 3 – A Logistics Organization

A large multi-national logistics company agreed to participate in this study. They are listed among Armstrong & Associates Top 50 US and Global Third-Party Logistics providers for 2020 (Burnson, 2020). This organization transitioned from the Waterfall method and has been using SAFe® for over five years for their software development practices.

The logistics organization uses the "Portfolio" configuration of SAFe®, that is, they are using SAFe® at the Portfolio, Program and team levels. Backlogs are in place at each of these levels and a single management tool is used to manage priorities and provide transparency for all planned work and work-in-process. Today the software development organization using SAFe® is comprised of over 175 multifunctional team members serving in various portfolio, program and team level roles.

Interviewee Profiles

The interviewees included an IT Director, Application Development Lead and a Release Train Engineer. All three participants have been with the organization since before the transition, were directly involved with the transition, and are using SAFe® today. Each holds SAFe® certifications in their respective area. The average number of years of SAFe® experience amongst the three respondents is greater than 5 years.

RQ1a: Organizational Outcomes

Participants were first asked the effectiveness of SAFe® on organizational outcomes. Questions in this area included the business drivers for selecting SAFe®, trends in performance since the transition to SAFe® and the perceived effectiveness of SAFe® practices for strategic alignment. The participants were also asked to share their perception of the benefits realized

through efficiencies gained or outcomes improved and to share any challenges they perceived while implementing or challenges that remained afterwards.

When presented questions regarding the business drivers for transitioning to SAFe®, the respondents agreed on the need to "increase business agility" through "faster cycle times," and increase "speed to market." One said we "just needed to become more agile." Another described the driver as "a failure of Waterfall" to support the need to "scale properly" and "handle the complexity and speed needed" in their environment.

Using Waterfall, the organization released software approximately every nine to twelve months. When the organization initially transitioned to SAFe® the former release cycles were replaced with two-week iterations. This allowed the organization to deliver strategically aligned and prioritized new software features every two weeks. Today, the team has since scaled up to over 15 teams and releasing software every two weeks and are currently considering moving to a weekly release cycle.

The Key Performance Indicators this organization began with were "initially about the rollout of SAFe®" like "how many teams have started using SAFe®." Today "performance-based measures" are in place that include: "cycle times," "feature completion rates," "business value delivered," "concept to cash," "team velocity is measured by consistency of feature completion rates," and "working software" measured by "customer feedback and rework rates."

When asked about the practices to help strategically align their work, the interviewees said they "focus on the core SAFe® principles" of a "Lean-Agile mindset," "DevSecOps" and "Design thinking" with "guardrails" and "value streams" to "guide the business investments." The SAFe® practices cited as the most effective to align organizational strategies included Lean Portfolio Management, Portfolio Canvas, Portfolio Roadmap and Program Increment Planning.

One interviewee said, “we love PIs” because “the business prioritizes the work” and it has allowed us to “increase our effectiveness” and “business impact.”

Several benefits were provided regarding the perceived effectiveness of SAFe® on the organization. One respondent said that SAFe® provides “program alignment and consistency along the lines of flow and transparency at the Program level.” They went on to say “it’s not a fantasy that it works” in that they can see the flow of work at every step of the process. Another said the using SAFe® they are able to “develop thin slices of business capability” and when comparing SAFe® to Waterfall they noted that “smaller features are better” by enabling agility needed.

A challenge noted provided was that while the software development team are now using SAFe®, some supporting organizations, specifically the “infrastructure [organization] lags behind the development support areas” and “they still use Waterfall.” The “lack of alignment of methods and schedules” impacts “our ability to innovate quickly” because the underlying “hardware, third party software and operating systems” “take longer” and “are reliant on external vendors.”

RQ1b: Self-Organization

The perceived effectiveness of self-organized teams was then discussed. Interviewees with also asked about and the benefits achieved, and challenges encountered or those challenges that remained.

All three participants stated this organization is using self-organizing practices “at all levels.” They noted that “value streams are self-organized” “autonomous units” where “they plan [their work] themselves with goals and guardrails” to guide that work. Value stream maintain strategic alignment by using SAFe® practices including “PI planning,” with “PO and ART

Syncs" and based on "guardrails" used to oversee the work with "checkpoints by the PO, RTE and Scrum Master."

The respondents provided no specific challenges in this area as evidenced by one saying there are "no major problems" in this area.

RQ1c: Non-Linear Relationships

Participants were queried on their perception of the effectiveness of SAFe® practices in engaging stakeholders at all levels. The participants were also requested to discuss perceived benefits or challenges in this area.

This organization uses several SAFe® practices that enhance collaboration and communications with key stakeholders. They maintain a "communications plan" and "stakeholder register" where "communications are identified, categorized, and prioritized." Then they determine who to involve in the meetings based on these artifacts. The most efficient means of communications are found in the use of SAFe® "ceremonies" at the "Portfolio, Train [Program] and Team" levels that include the Portfolio Sync, ART Sync and Portfolio Backlog Refinement sessions. One said they maintain "active business partner involvement" throughout the process. This participant provided an example of how this helps with "Epics, Features and [User] Stories are written as conversations" so they don't only understand what is being requested but also "understand the need to develop it." The benefits noted include faster delivery of high priority and a better understanding of business needs.

This organization also uses customer satisfaction surveys and direct customer interaction through User Experience (UX) design sessions as inputs in the planning process. One interviewee said they have "adopted UX practices and mock up designs directly with end users", which in turn provide a better understanding of the requirements. And that by using UX design it

allows for “innovations and improvements” that “may have not been considered without” this practice. Another participant cited a benefit of the enhanced collaboration between business and IT by saying “it is very dangerous when IT runs the company.”

Challenges experienced early on have, for the most part subsided. One stated that “when we first started in 2014, there was initial push back.” Once the process “starting churning out work” they saw “more [business people] coming on board.” This is evidenced by their statement that early “success spoke volumes to the business side.”

RQ1d: Managing Emergence

Emergence is realized through requirements for new features provided by the software. Questions regarding the perceived effectiveness of SAFe® practices in the management and prioritization of software requirements, handling of emerging and emergency changes were discussed. The challenges and benefits were also requested.

The participants were quick to point out that there are no “urgent changes.” The participants shared that “unplanned changes” followed the “same process” as those that are “planned.” This is managed by the “Product side of the Portfolio Governance Process.” Two participants said, “contingency or reserve” is available in each PI “to accommodate unplanned changes.” Like other changes, the requests are “assessed for priority” and if needed, “tradeoffs” are assessed if the new requests took precedence due to their higher priority.

The primary challenge discussed was the ability to maintain a roadmap “eight or nine months out.” This is due to new feature requests continually entering the backlog and the continuous (re)prioritization of the work. With releases every two weeks, and soon weekly releases, along with “innovations discovered” makes it hard to “see that far out.” Another noted challenge was that there may be interdependent organizations that are not using SAFe® (e.g.,

Infrastructure), which could impact the delivery due to schedules and methods being misaligned. In this case the infrastructure team is on a different and longer-term schedule due to their continued use of the Waterfall method. This has been shown to have an impact on innovation considering the software team may require a "non-standard" underlying infrastructure configuration. There may also be external dependencies on third party vendors providing hardware and software that the business software is built upon or leverages. This situation may result in delays due to misaligned delivery timelines.

Overall Perceived Effectiveness Findings

At the end of each interview, summary questions were asked regarding their overall perception of the effectiveness of SAFe®. Questions were presented in regard to efficiencies gained, challenges that remained and final questions regarding anything unexpected that they found when transitioning to SAFe® and their overall perception of its effectiveness.

One participant stated the greatest efficiency gains were due to the introduction of the "business into the overall process." This helped set the "cadence and priorities" for the team which resulted in a "greater understanding and sense of purpose" by aligning the business and IT teams. One interviewee found that the ability to manage the work "as a portfolio" rather than as "individual requests" provided the greatest efficiencies in terms of "business IT alignment." Another perspective shared was "at the team level the ability to break down work and get it done" quickly was the greatest benefit.

The greatest perceived challenges cited by all participants were the organization change management aspects of transitioning and the alignment with non-SAFe® business units. One participant described the need for organizational change management to include not only business and IT roles but also include "HR, Legal, and Finance" organizations. The transition to

SAFe® is a "significant mindset shift" and the changes go much farther than a "need for new job descriptions."

Non-SAFe® organizations were described as the "infrastructure organization is not aligned" with the development team's "priorities or schedules." Another challenge was described as "dependency management between the value streams." Since each value steam acts autonomously there is a need to align the "solution trains to achieve true scaling." This impacts the "underlying architecture and workflow" across all teams.

When asked if they perceive SAFe® as an effective framework, one said "yes" but reiterated "as a framework." All three shared (separately) that "SAFe® is not a prescribed set of steps" but it provides guidance. It is important to note that it starts by applying a "Lean Agile mindset then you make it work for you." Another participant described the mindset change by saying "we moved from a command and control environment to self-organized teams." While it was difficult at the beginning it "evolved and became easier over time."

Summary of Qualitative Findings

SAFe® is based on ten core Lean-Agile principles that support the measures of effectiveness for complex adaptive systems. These guiding principles permeate throughout the roles and practices contained within the framework. Taking and economic view, applying systems thinking, assuming variability, building incrementally, basing objectives on working systems, visualizing and limiting work in progress, cross-domain planning, considering worker motivation, decentralizing decision making and organizing around value (Scaled Agile Inc., 2020) support the measures of effectiveness for complex adaptive systems.

Throughout the interviews with the three organizations while discussing the SAFe® practices supporting each research question, the underlying Lean-Agile tenets were prevalent.

All interview participants cited “transparency” of both planned work and work in progress, “continuous prioritization” and “alignment” to strategic objectives as critical factors in achieving their organizational goals. In all three cases, the transition from Waterfall to SAFe® helped the organizations establish Lean-Agile practices that improved strategic alignment, facilitated business / IT alignment, shortened cycle times and reduced rework which resulted in lower operational costs and increased customer satisfaction.

Common themes emerged by comparing responses across all participants. Affinities for each research question were consolidated and this section presents a summary of findings for each research question regarding the perceived effectiveness of SAFe®.

RQ1a: Organizational Outcomes Summary

Across the organizations interviewed, common business drivers included the desire to increase the “speed of delivery,” “coordinate multiple interdependent teams,” “improve software product quality,” “eliminate waste” and “improve organizational agility” to respond to changes in business priorities. These guiding principles set the stage to achieve the goals and the SAFe®. Common practices that were cited as most helpful to achieve these goals included: Portfolio Roadmap, Program Increment Planning, Program Backlog Refinement, and PO/ART Syncs. These practices are helping with strategic alignment through “transparency” and continuous “prioritization” made possible by using centralized management tools and common practices.

All three organizations said with the introduction SAFe® and Agile approaches they were using “Story Points” to measure “Velocity.” All teams now use “Burnup charts” to measure velocity (throughput). This also provides insight to determine if additional scope was introduced in an iteration. Additional measures of performance include “Customer experience” scores as “leading indicators based on measuring system performance and customer feedback” and

"working software" is a common expected outcome of SAFe® and Agile. By "taking thin layers of features" versus taking on all of the work at once (with Waterfall) and by working closely with the business to "fully understand the requirements" and "prototyping" before the development cycle the amount of rework was significantly reduced.

Direct, tangible benefits are realized as reduced costs from improved cycle times and reduced rework. By developing in short cycles, the organizations have significantly improved their business agility and can respond much faster to emerging business priorities. In the past with Waterfall, many identified a key issue is that since the development cycles were so long, often 9-12 months versus two weeks with SAFe®, there was much waste because the business needs changed significantly in that time.

Organizational Change Management, training, stakeholder engagement and interactions with non-SAFe® organizations were cited as the principle challenges. The transition to SAFe® permeates all aspects of the organization beyond the business and IT units. Impacts include organizational governance, management structures, reporting structures and changes in individual roles. Contracting, HR, Legal and Finance organizations have a role in the change as well. Training becomes of vital importance early on so that those involved can quickly assimilate their new structure, roles and responsibilities.

Another significant change is that of the metrics used to assess performance. The interviewees found that it was difficult for some in the organizations to move from common project management measure (e.g., cost, scope, schedule, earned value) to SAFe® measures of throughput (i.e., Velocity) and value (i.e., prioritized features based on business value).

Finally, interactions with non-SAFe® organizations can result in long lead times if the other team is still using Waterfall. Schedules and priorities may be misaligned when supporting organizations using Waterfall are not aligned with SAFe® planning or vice versa.

RQ1b: Self-Organization Summary

The three organizations described varying levels of adoption of self-organization practices. While SAFe® supports this construct at all levels through value streams, only one of the three organizations shared that is the level in which they are using this practice. Each organization described their usage of self-organization at the team level, however, one had significant evidence that they were working at a higher level. In the other two cases, this concept was only partially applied at the team level.

Based on the information collected it appears that self-organization is very difficult to attain across all levels. As one respondent noted, self-organization "is a trust process" and that "teams need time to build trust." The team is this context needs to include management. Each of the three case studies presented a need for organizational change management to aid in the "decentralization of decision-making" to enable "autonomy for team members" to fully realize this goal.

RQ1c: Non-Linear Relationship Summary

All three organizations were using several SAFe® "ceremonies" to manage non-linear relationships. Common practices included the use of PI Planning, Program Backlog Refinement, Product Owner Sync, ART Sync [with the customers], Scrum of Scrums [with the team only] and "demos" [with all stakeholders] at the end of the cycle to share the outcome of an iteration. In addition, all the organizations stated they use of "prototypes" to facilitate a common understanding of the requirements before the development cycle.

The benefits of SAFe® collaboration practices with direct customer representation lead to "improved morale" for both business and IT teams through a "mutual understanding of expectations." The introduction of a Product Owner playing a critical role in centralizing decision making on behalf of the business was a commonly cited benefit. Using SAFE® practices drove "faster decision-making and approvals," ultimately "resulting in reduced rework," "improved product acceptance" and "greater customer satisfaction."

A few challenges were noted that include the need for organizational change management, training, and stakeholder "expectation management." One team was concurrently providing training while working to affect the transition. The need for organizational change management was a common theme across all cases in order to reduce "push back" and aid in the transition. Push back was manifested in multiple ways from passive, by not attending meetings or sending unqualified delegates, to more active push back by requiring the new process to follow the former rules and organizational structures or more overt measures where manager actively resisted. In most cases, once this challenge was bridged, "success spoke volumes to the business side" and helped reduce some resistance.

RQ1d: Managing Emergence Summary

Emergence in this context is realized through requirements for new features provided by the software. The participants noted many sources of "planned and unplanned changes." One interviewee described a commonly used SAFe® practice that allowing for multiple "pivot points where you can accept change" within the "built in contingency" within a PI.

For "urgent changes" (or any change) the team conducts an analysis using "quantitative, qualitative and business value measures." If then the "urgent" or "emergency" change results in a higher priority than the currently scheduled work based on this analysis it will be added at the

next opportunity. The interviewees across all case studies also noted that for mid-sprint "urgent" changes, the Product Owner is a key decision maker in assessing the risks and downstream impacts of the "tradeoffs that would have to be made" to accommodate the unplanned work. The teams would prepare a quantitative and qualitative impact statement on business value of potential tradeoffs to aid in this decision.

In all three studies, the interviewees noted two common primary challenges. The first challenge is that the process should not change for "emergency" requests. If the team reacts and responds differently for "unplanned" changes, that behavior would erode the foundational concepts of planning and prioritization. The other challenge is that the Product Owner must only have one role and cannot also be the Product Manager. This would create a conflict in their responsibilities between "business prioritization" and "speed of delivery."

Quantitative Findings

An existing validated online survey was used to address the fifth research question (RQ1e) regarding the participant organizations' perception of their level of organizational agility. The "Organizational Agility Profiler Survey" developed by Worley et al. (2014b) and governed by the Center for Effective Organizations (CEO), at University of California's Marshall School of Business was used to address this research question. This instrument includes 20 questions that measure four core routines of organizational agility that include (Worley et al., 2014):

- Strategizing – How top management teams establish an aspirational purpose, develop a widely shared strategy, and manage the climate and commitment to execution.

- Perceiving – The process of broadly, deeply, and continuously monitoring the environment to sense changes and rapidly communicate these perceptions to decision makers, who interpret and formulate appropriate responses.
- Testing – How the organization sets up, runs, and learns from experiments.
- Implementing – How the organization maintains its ability and capacity to implement changes, both incremental and discontinuous, as well as its ability to verify the contribution of execution to performance.

RQ1e: Organization Agility Summary

The "Organizational Agility Profiler Survey" developed by Worley et al. (2014b) and governed by the Center for Effective Organizations (CEO), at University of California's Marshall School of Business was used to assess organizational agility. The findings presented in Chapter 5 indicate a high level of agility in the core routines of agility across all organizations studied. This is consistent with the findings in the qualitative portion of the study.

As previously discussed, if organizations periodically administer the survey it can provide trends in the various routines. This can become an important management tool to understand the overall condition and further investigation based on the scores can be undertaken to determine the underlying situations affecting the scoring.

RQ1e: Survey Responses

Each organization was asked to provide six participants for the online survey. A total of 18 surveys were initiated, however only 11 responses were usable across all three organizations Within the Qualtrics survey the tool recorded that "This question was not displayed to the respondent." It is unclear why this condition was found. One person suggested internal firewall rules may be blocking access to complete the survey. Due to the survey being administered

anonymously, it wasn't possible to determine who encountered this condition to ask them to retry. Because of the lower than expected response rate, the findings were aggregated across all three organizations versus presented for each organization and are presented below.

The four core routines are coded based on four or five questions presented in the survey (i.e., Strategizing, 4; Perceiving, 5; Testing, 5; and Implementing, 5) with equal weight for each question resulting in an average composite score for that routine. Figure 11 presents an aggregate view of findings for all organizations.

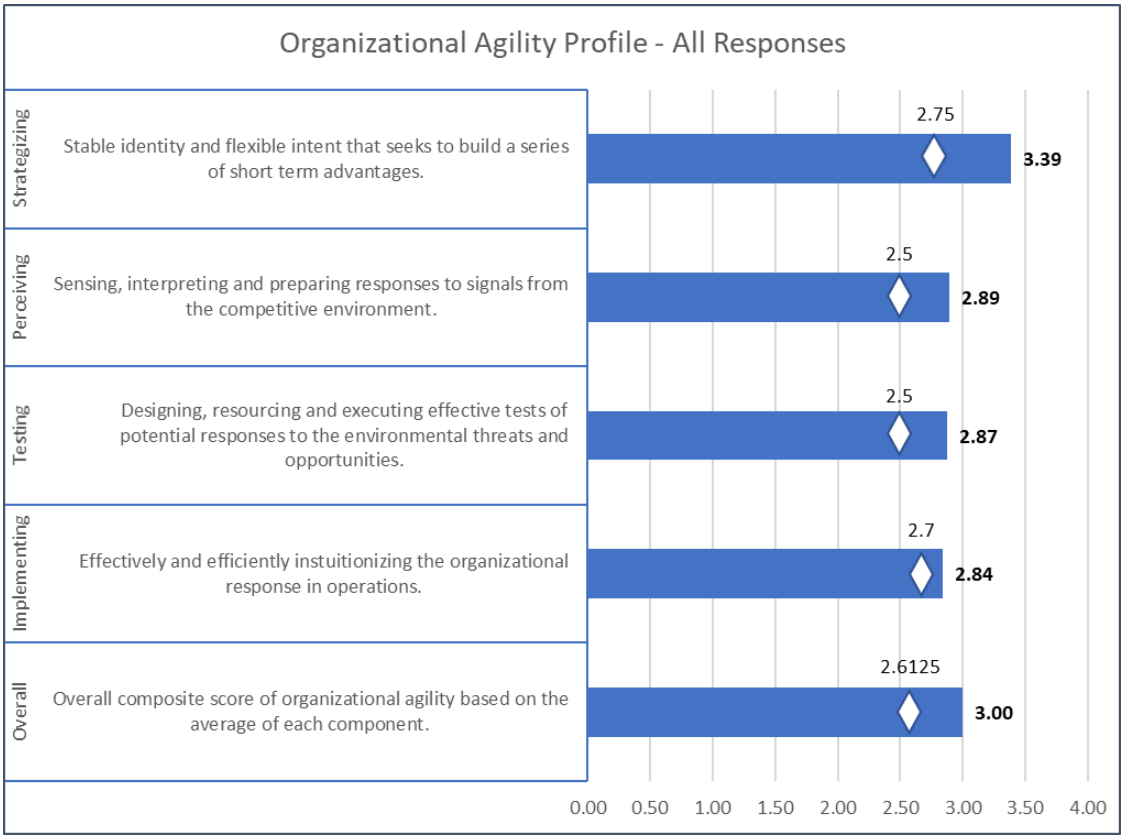

Figure 11. Aggregate Organizational Agility Scores depict a high level of agility in all areas.

The diamonds in the chart represent the baseline thresholds for each area. Scores above the baseline are considered higher than average, conversely those below the baseline are considered lower than the average. Based on a consolidated view across all three organizations,

all scores are above the baseline thresholds (i.e., Strategizing: 2.75, Perceiving: 2.5, Testing: 2.5, Implementing: 2.7).

The survey also included a question regarding the organizational level (Portfolio, Program or Team) for each response. Table 16 presents the findings by organizational level.

Table 16

RQ1e: Survey Responses by Organizational Level

Research Question	Portfolio	Program	Team	Mean	Threshold
Strategizing	3.63	3.44	3.25	3.44	2.75
Perceiving	3.40	3.00	2.60	3.00	2.50
Testing	3.50	2.65	2.80	2.98	2.50
Implementing	3.30	2.55	2.88	2.91	2.70

The findings presented in both Figure 11 and Table 16 regarding the perceived level of agility represent what the survey authors term “strong form” agile organizations. In order to be considered “strong form”, the implementing score and at least two of the remaining three routines need to score above the baseline threshold for each routine (Worley et al., 2014). The survey is scored by using a capital letter for a routine above the baseline and lower case for scores below the threshold. In this case the score is all capital letters – SPTI. The authors consider SPTI, sPTI, SpTI and SPtI as “strong form” agile organizations (Worley et al., 2014b). The interpretation for each routine is discussed below.

Strong “strategizing” scores indicate management has effectively communicated the strategic intent and the respondents perceive a shared sense of purpose. This is also indicative of an organization that embraces change (Worley et al., 2014b). The aggregate score from this study was 3.39, much above the 2.75 baseline. Individually, 82% (9 of 11) participants scored above the baseline (3.56) and the score for the other two participants averaged 2.50. In addition,

Table 16 shows scores above the baseline at all levels. Having a weak “strategizing” routine demonstrates that the organization may not have or may not communicate a unifying purpose other than profitability and growth, or the organization is less culturally open to embrace change.

Strong “perceiving” scores are associated with how the organization collects and disseminates information from external sources throughout the organization. Strong scores in this area also indicate the flexibility to change internal processes and products based on external influences (e.g., regulatory, market, customer demands). The aggregate score from this study was 2.89, 0.39 above the 2.5 baseline. Individually, 82% (9 of 11) participants scored above the baseline (3.0) and the aggregate score of the other two was 2.4. In addition, Table 16 shows scores above the baseline at all levels. Having a weak “perceiving” routine may indicate a reactive organization that adjusts to market conditions or customer needs only when necessary (Worley et al., 2014b).

Scores above the baseline for the “testing” routine are associated with the organization’s tolerance for risk, experimentation and failure. It is also indicative of an organization that innovates, exploits opportunities, and effectively shares learning across the organization. The aggregate score from this study was 2.87, 0.37 above the 2.5 baseline. Individually, 82% (9 of 11) participants scored above the baseline (3.03) and the aggregate score of the other two was 2.0. Table 16 shows scores above the baseline at all organizational levels. Organizations with a weak “testing” should explore allocating resources to test innovations and new ideas. These organizational are encouraged to develop more effective learning processes (Worley et al., 2014b).

As discussed above, “implementing” scores are core to the overall assessment. Strong “implementing” scores are associated with mature management systems that include: goal

setting, leadership development, incentive systems, and budgeting processes (Worley et al., 2014b) that support the ability to implement internal processes based on the other inputs. The aggregate score from this study was 2.84, 0.14 above the baseline of 2.7. In reviewing individual responses, 64% (7 of 11) reported their perception above the baseline. Based on the data in Table 16, it appears that the perception is lower (2.55) at the "program" level. Regardless of the other routine scores, if the organization has an "implementing" routine score below the baseline, their overall agility score will be result in a "weak form".

The authors also note that a confirmation of these scores should be substantiated by other objective assessments. The agility scores appear to be in alignment with the qualitative findings. Finally, the scores represent the level of agility at a point in time. The authors suggest periodic surveys should be conducted to check the organization's long-term performance to determine if the agility routine scores trend in one direction or another over time.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

As described earlier, software development projects experience very high rates of failure (Ahimbisibwe et al., 2015; Charette, 2005; Chiyangwa & Mkandla, 2017; El Emam & Koru, 2008; The Standish Group, 2015). Because of the significant impact of software development project failure to organizational costs, many studies (Amjad et al., 2018; Anthopoulos et al., 2016; Cecez-Kecmanovic et al., 2014; Gulla, 2012; Hamidi, 2014; Hughes et al., 2017; Krigsman, 2009; Stoica & Brouse, 2013; Wiklund & Pucciarelli, 2009) have been conducted to determine the root causes and possible solutions to address these failures. The literature suggests failure rates of software development projects are closely tied to the software development method used (Ambler, 2018; Cao, 2006; Gemino et al., 2007; Joslin & Müller, 2015; Nasir & Sahibuddin, 2011; Pace, 2017; The Standish Group, 2015; Wells, 2012; Wright 2013).

In the 1980s through early 2000s new software development methods, collectively termed “Agile methods”, were introduced and had the general effect of improving software development rates. However, these methods were designed for small teams of less than 15 people. A group of “Large-Scale Agile” software development methods are starting to emerge. Organizations are interested in not only expanding upon the success of Agile methods at the team level but are also interested in introducing new governance and organizational oversight

models (Alqudah & Razali, 2016). The Scaled Agile Framework (SAFe®) is the most popular large-scale agile method (CollabNet, 2019) used today and therefore was selected for this study.

Conclusion and Discussion

This study's purpose was to determine the extent of perceived effectiveness of the Scaled Agile Framework® in software development organizations using Complex Adaptive Systems as a lens to guide the study. In order to measure the perceived effectiveness of SAFe® practices, one primary and five supporting research questions were developed in alignment with the core elements of Complex Adaptive Systems theory that include:

- RQ1: What is the extent of perceived effectiveness of the Scaled Agile Framework® in software development organizations using Complex Adaptive Systems as a lens to guide the study?
    - RQ1a: How and to what overall perceived effect are software development organizations using SAFe® to measure organizational outcomes?
    - RQ1b: How and to what overall perceived effect are software development organizations using SAFe® to manage self-organization/self-organized teams?
    - RQ1c: How and to what overall perceived effect are software development organizations using SAFe® to manage non-linear relationships?
    - RQ1d: How and to what overall perceived effect are software development organizations using SAFe® to manage emergent requirements?
    - RQ1e: How and to what overall perceived effect are software development organizations using SAFe® to support organizational agility?

The sections below consider practices from both a SAFe® framework capability and from those practices actually in use.

RQ1: Perceived Effectiveness of SAFe®

Throughout the data collection activities, several themes regarding the perceived efficiencies of SAFe® were collected and categorized in support of the primary research question: "What is the extent of perceived effectiveness of the Scaled Agile Framework® in software development organizations using Complex Adaptive Systems as a lens to guide the study?" Table 17 presents a summary of the overall perceived efficiency gains and benefits achieved using SAFe®.

Table 17

Summary of Perceived Efficiencies and Benefits

Research Question	Perceived Efficiency / Benefit
RQ1a: Organizational Outcomes	• Increased the speed of delivery/accelerated time to market and reduced risk through shorter development cycles • Increased productivity by focusing on high priority work • Enhanced software quality and lower rework complexity through design thinking and prototyping • Reduced overall costs by applying Lean-Agile principles included in SAFe® • Enhanced product design through UX, prototyping, and customer feedback cycles
RQ1b: Self-Organization	• Improved team morale for both business and IT representatives with self-organized teams and decentralized decision making. • Enhanced collaboration processes resulting in more inclusion of distributed teams
RQ1c: Non-Linearity Relationships	• Improved strategic alignment with business objectives through continuous prioritization. • Higher customer engagement resulting in increased customer satisfaction • Increased project/program visibility through dashboards that demonstrate work-in-progress is aligned with organizational priorities.

Research Question	Perceived Efficiency / Benefit
RQ1d: Emergence	• Enhanced the ability to manage changing priorities • Simplified software development processes
RQ1e: Agility	• Increased business agility through shorter development cycles and ongoing prioritization

In addition to efficiency gains and benefits, several significant challenges were noted throughout the study, a summary of findings is provided in Table 18.

Table 18

Summary of Perceived Challenges

Research Question	Perceived Challenge
RQ1a: Organizational Outcomes	• Organizational change management • Organization, Process and Job/Performer Training • Selecting and applying new performance measures • Interactions with non-SAFe® organizations • Hybridization of SAFe® and Waterfall practices
RQ1b: Self-Organization	• Management support for decentralized decision-making • Self-organization practices at program and portfolio levels
RQ1c: Non-Linearity Relationships	• Consistent and active participation of the "right" stakeholders • Knowledge of and / or access to customers and / or end-users
RQ1d: Emergence	• Management and prioritization of "emergency" change requests
RQ1e: Agility	• The participants did not present any significant challenges based on the interviews or survey responses.

Details to support the findings including evidence from the data collection activities are presented in the subsections below.

RQ1a: Organizational Outcomes Summary

The interview questions expanded upon this question to better understand the interviewees' perceptions regarding: how organizational goals (outcomes) are developed and

managed, what metrics are used to measure these outcomes, if the organizations have seen trends (in either direction) after transitioning to SAFe®, and which SAFe® practices provided the greatest benefits. The interviewees were also asked to describe any challenges encountered in this area.

The organizations in this study described a top-down approach when discussing the how the organizational goals were derived and managed. While only two of the three participating organizations are using SAFe® at the Portfolio level, the third also used some practices at this level to align with organizational goals. The SAFe® practice of Strategic Themes was used by all organizations to document the business objectives for each portfolio to align with organizational strategies based on changes in the external environment. While several other portfolio level practices were used by two participating organizations, the common SAFe® practices used across all three were Strategic Themes, Program Increment Planning, Program Backlog Refinement, Product Owner Sync and ART Sync to identify objectives and maintain strategic alignment throughout the lifecycle. The Product Owner plays a critical role in supporting strategic alignment due to their central role in decision making relative to determining priorities of the work performed.

When asked about the business drivers of selecting SAFe®, many objectives and key results (OKRs) results were discussed. By developing in short cycles, the organizations have significantly improved their software development agility and can respond much faster to emerging business priorities. In the past with Waterfall, many identified a key issue was due to long development cycles, often 9-12 months versus two weeks with SAFe®, there was much waste because the business needs changed significantly in that time. By transitioning to SAFe® the organizations reported the realization of direct, tangible benefits that included: increased

speed of delivery, risk reduction, increased productivity, enhanced software quality, reduced rework complexity, reduced costs, enhanced product design, and increased agility in the software development function.

Principle challenges noted included: change management, training, performance measures and interactions with non-SAFe® organizations. By transitioning to SAFe® organizational governance, management structures and individual roles changed. Training becomes of vital importance early on so that those involved can quickly assimilate the new structure, roles and responsibilities. Another significant change is that of the metrics used to assess performance. The interviewees found that it was difficult for some in the organizations to move from common project management measure (e.g., cost, scope, schedule, earned value) to SAFe® measures of throughput (i.e., Velocity, working software) and value (i.e., prioritized features based on business value). Interactions with non-SAFe® organizations can result in long lead times if the other team is still using Waterfall. Schedules and priorities may be misaligned when supporting organizations using Waterfall are not aligned with SAFe® planning or vice versa.

RQ1b: Self-Organization Summary

The interview questions expanded upon this to better understand at which levels (i.e., Portfolio, Program, Team) self-organization in applied. The interviewees were also asked about their perceptions regarding the SAFe® practices that provided the greatest benefits in this area and any challenges they encountered.

SAFe® supports this construct at all levels using value streams as semi-autonomous self-organized constructs. Outside of the value streams (at the Portfolio level), the research suggests self-organization is primarily practiced at the team level. The organizations described their use of

self-organization as the ability of the team members to select their own work based on the priorities and their specific area of interest or competency. The participants noted that by allowing individuals to select their work, the individuals were not only able to work in areas they were familiar, but through paired programming, they were able to learn new skills with the help of more experienced team members. The interviewees stated this resulted in higher morale and improved job performance.

All teams help in prioritization as information sharing is cascaded top down and bottom up through SAFe® ceremonies (meetings). To support this information flow, SAFe® applies the concept of "servant leader." The Solution Train Engineer, Release Train Engineer, and Scrum Masters (at the Portfolio, Program and Team levels respectively) serve in this role and are responsible for facilitating the events and overseeing the processes in order to assist the teams in delivering value.

The interviewees noted that the SAFe® practices that support self-organization are those that support prioritization, alignment and transparency. The practices most often cited in this area were Program Increment Planning, Program Backlog Refinement, ART Sync, Scrum of Scrums and Daily Scrum. The Product Owner is responsible for "what" is performed from a prioritization perspective. The team members then collaborate at each level, facilitated by the STE, RTE or Scrum Master to determine "how" the work is performed. By using these practices, the team members were not only able to understand the type of work being requested, but this helped them plan for upcoming activities in which they could choose to participate to broaden their skillset or apply their knowledge. The findings here are consistent with those of Goodman, Devadas and Griffith-Hughson (1988) where an analysis of 70 studies concluded that the use of self-managed groups had a positive impact on productivity.

Although SAFe® has practices to support self-organization at all levels, only one (the logistics organization) of the three organizations shared evidence of this occurring within their organization. It is difficult to determine the impetus for this one organization applying these practices at all levels based on the study responses. On the surface, this and another organization have been using SAFe® for about the same amount of time, six and five years respectively. However, the software development organization applying these practices at the program and portfolio levels is a factor of three times the size of the other organization. Another potential factor may be process maturity. The SAFe® practices described by the interviewees point to more robust usage of portfolio practices and other core competencies that included Design Thinking and Lean-Agile management. Based on these factors, one might consider that size or management support are factors that drove process maturity, however, there are many more potential reasons that could have resulted in the usage at the levels discussed.

This team setup Solution Train Engineers to manage the overall value streams, Release Train Engineers to facilitate Scrum of Scrums at the Program Level, and Scrum Masters at the team level. The other two organizations described their use of self-organization to be occurring primarily at the team level. Scrum team members practice self-organization by having insight into the prioritized work and "having a say" in the selection of work to perform on an individual basis, based on this prioritized backlog. A "sense of purpose" through a common understanding of the customer's needs, and "having a say" in the work performed were cited as supporting practices for self-organization. The benefits noted from the interviews included improved morale and autonomy within the scrum teams and support for collaboration with distributed teams.

The interviewees from the retail organization cited a challenge related to management's lack of support for decentralized decision-making as having an effect on self-organization. They

noted that the challenges were exasperated by moving from a centralized management structure, using waterfall, to a decentralized structure without full management support and training. Since the change was initiated as a transactional versus transformation (as described in the Burke-Litwin Model, 2018), the interviewees noted that the transition to SAFe® didn't garner executive support early and took a long time to gain consensus and acceptance. This may have led to a situation described by Rummler et al. (2010) where "the concept dies a quick but embarrassing death because nobody knows what to do or it leads to turf battles between process owners and line managers" (pp. 39-40) in regard to self-organization at the program and portfolio levels.

Additional challenges noted in this area are that "teams build trust over time." Several participants stated that it can be counterproductive for management to continually change out team members. One may interpret this comment as described by Burke (2018), in order to for self-managed teams to be effective, "group members must learn to share power and leadership" and they need time to "effectively learn to manage differences and conflicts" (p. 119).

Finally, the participants noted that the "right" stakeholders are needed to provide consistent participation to achieve the benefits. Many said that as the program and portfolio practices become more mature, self-organization will also grow in these areas. One might challenge this final statement considering one organization has been using SAFe® for over five years and have not achieved self-organization at all levels.

RQ1c: Non-Linear Relationship Summary

The interview questions expanded upon this to better understand how the teams interacted with the new and former methods and how ultimately the voice of the customer was brought into the software development process. The interviewees were also asked about their

perceptions regarding the SAFe® practices that provided the greatest benefits in this area and any challenges they encountered.

Prior to transitioning to SAFe®, all three organizations were formerly using a Waterfall approach. Using SAFe®, the requirements, development and testing functions are integrated enhancing communications between these functions. The interviewees described the Waterfall approach as "siloed" where information was passed between IT teams at the end of each phase and the primary interaction between the teams consisted of a meeting to discuss the "turn over" documents. Studies have found this created significant rework at the end due to the misalignments in understanding the requirements due to a lack of multi-level collaboration cycle (Ji & Sedano, 2011). The study participants shared that the combination of using multi-functional teams and having direct access to the product owners and business analysts help with the understanding of the business needs throughout the process.

SAFe® includes several practices to facilitate non-linear communications and stakeholder engagement between both business and IT communities. Using SAFe® the business and IT organizations regularly meet in a number of forums for information sharing throughout the life cycle (versus primarily at the beginning and end). The most effective SAFe® collaboration practices cited by the study participants included the Portfolio Sync, ART Sync, Product Owner Sync and Portfolio Backlog Refinement sessions. In these sessions, requirements are elicited and documented, and priorities are reviewed. With short two-week iterations, these practices were perceived as critical to support the throughput needed to maintain two-week iterations. The participants cited the combination of enhanced communications and shorter development cycles as a key to reducing overall rework and complexity of any rework needed.

SAFe® practices also drove faster decision-making and approvals. The retail organization described the approval process as taking “weeks” to obtain. With the establishment of the Product Owner function, approvals are now “part of the process”. Rather than the development team requesting approval, the work is prioritized by the business (facilitated by the Product Owner) in advance removing the need for approvals. By working closely with the customer on priorities and engaging the customer in prototype reviews at the beginning and systems demonstrations at the end of a cycle, the teams reported increased customer satisfaction.

A challenge noted in this area is maintaining the active involvement of the “right” stakeholders; those who know the business well enough to understand the organizational strategy and impacts of decisions relative to prioritization on achieving those strategies. SAFe® practices center around a representation of the “voice of the customer.” This representation is core to business/IT alignment and expectation management.

RQ1d: Managing Emergence Summary

A key component of organizational agility (at the core of SAFe®) is the ability to quickly respond to internal and external changes in the environment (Meso & Jain, 2006). From a software development team perspective, these are manifested in the emergence of requirements for the software products produced by the organization. Requirements may emerge from organizational goals, customer interactions, product goals, and requirements derived from the architecture and development teams (Scaled Agile, Inc., 2020). From a software development team perspective, these are manifested in the emergence of new features or changes in the software products produced by the organization.

Interviewees shared that SAFe® unlike its predecessor method, Waterfall, focuses on changes in short delivery periods which makes emergent change much easier to address due to

continually assessing the business value (priority) of work. If the emergent change is found to be a higher priority than the work planned for the next cycle, it will be included in that grouping. Study participants described a SAFe® best practice in this area is that they reserve a percentage of capacity within each iteration to accommodate change. Using this practice, emergence is supported by being able to either accommodate unforeseen needs or, if unneeded, the team may use this capacity to work on the next priority item in the backlog within a given iteration. Participants also noted that by analyzing all work and properly prioritizing the work, the true criticality of all work is known which in turn simplifies the software development process and "takes the emotion out" of making business decisions.

The interviewees noted that for mid-sprint "urgent" changes, the Product Owner is a key decision maker in assessing the risks and downstream impacts of the tradeoffs that would have to be made to accommodate the unplanned work. The teams prepare a quantitative and qualitative impact statement on business value of potential tradeoffs to aid in this decision.

The interviewees noted a challenge in that the "emergency" changes cannot become commonplace as they would erode the foundational concepts of planning and prioritization. All organizations studied discussed the process of assessing the business value for work planned as a key to keep from derailing the process. Finally, participants noted that the Product Owner must only have one role and cannot also be the Product Manager. If a person has both roles, a dual agency role situation would arise resulting in conflicting goals between business prioritization and speed of delivery.

RQ1e: Organization Agility Summary

Quantitative data supporting this research question was collected solely via a questionnaire, there were no specific qualitative questions presented in the interviews for this

section. The “Organizational Agility Profiler Survey” developed by Worley et al. (2014b) and governed by the Center for Effective Organizations (CEO), at University of California’s Marshall School of Business was used to assess the perceived level of organizational agility across all three organizations. The findings presented in Chapter 5 indicate a high level of perceived agility in the core routines of agility across all organizations studied. This is consistent with the findings in the qualitative portion of the study.

Theoretical Implications

The theoretical framework, Complex Adaptive Systems (CAS) theory, was selected as a lens to guide this study. A group of natural and social systems theorists originated this framework in the early 1980s at the Santa Fe Institute in New Mexico, USA to describe how the living world works (Pascale et al., 1999). John Miller and Scott Page (2009) wrote “the field of complex systems challenges the notion that by perfectly understanding the behavior of each component part of the system we will then understand the systems as a whole” (p. 3). In a software development process context, having great software development capabilities does not necessarily mean the customer will overwhelmingly accept and use the software product. Also considering Ahimbisibwe, Cavana and Daellenbach’s (2015) review of 148 articles found 37 critical success factors for software development, the complexity becomes even more apparent.

SAFe® supports many of the underlying constructs of CAS to a great extent, but there were some differences found in the study. The differences may be attributed to the implementation maturity found in the organizations studied or in the framework itself. CAS are generally defined as being composed of self-organized “populations of adaptive agents whose interactions result in complex non-linear dynamics, the results of which are emergent system phenomena” (Brownlee, 2007). Like other CAS, software development organizations have a

large number of “agents” (i.e., stakeholders) that interact and adapt or learn (Holland, 2002).

Organizational effectiveness measurements for CAS therefore consider the organizational goals and the outcomes of the system (Westerveld, 2003). The study participants described support for this area in that SAFe® focuses on inputs through prioritization of features and outputs in terms of “working software” and customer satisfaction. A software product is only successful if it is used and found valuable by those intended to use it. Using velocity as a key work-in-progress metric supports the need to quickly deliver valuable software in a timely manner.

In a CAS, self-organization is a bottom-up process where an organization emerges at multiple levels based on interactions of lower-level entities. The findings supported self-organization performed at the “lower” levels (team and program) where the team has an internal locus of control relative to “how” the work is performed. “What” work is performed was generally found to be determined top-down, generally at the Portfolio level. While some may point out that some features are informed by the “lower” levels, the work must be strategically aligned, and that direction was found generally initiated at a “higher” level.

CAS describes interactions among agents as non-linear. SAFe® uses three levels to describe where the work is performed, however, there is a network of associations that cross levels by organizing work around value streams or affinities of business capabilities.

Emergence in CAS refers to unanticipated features and behaviors that “emerge” only as individual entities are aggregated and interact (Roundy et al., 2018). These emergent needs or new feature requests are a bi-product of the software development process and often are realized during the inspect and adapt event. Using SAFe® emergence is also fully supported through short iterations of software development, the ability to assess priorities every two weeks.

In a CAS, there is no separation between a system and its environment in that a system always adapts to a changing environment (Chan, 2001). The findings from the on-line survey find a high level of organizational agility in all three organizations studied. The survey measured organization's ability to sense and respond to changes in the environment and internal management controls that support that ability.

Based on the findings above, Complex Adaptative Systems theory was an appropriate lens for the study and both the SAFe® framework and the research findings were generally in line with this model.

While CAS was used as a lens to organize and describe the interactions throughout this research, the Burke-Litwin Model of organizational performance and change was also be applied to review the effectiveness of the integration of SAFe® practices in software development organizations. As noted earlier, the Burke-Litwin model describes transformational and transactional dimensions of change. While informed and aligned with activities at the transformational level, one can make a case that SAFe® primarily focuses on components at the transactional level.

The introduction of SAFe® brought with it a significant change from Waterfall in terms of structure, management practices, systems (policies and procedures), work climate, task requirements and individual skills requirements, motivation and individual needs and values collectively resulting in changes in individual and organizational performance. Governance, reporting relationships, span of control, procedures, measures for both individual and team performance and even organizational roles were changed. As noted above, this type of change required management support and significant training and came with much "push back" early on. Once adopted, the organizations described positive benefits, yet challenges remained and are

described in the findings and conclusions presented earlier.

Human Resource Development Implications

The major area of specialization for this researcher is that of Human Resource Development (HRD) and Industrial Training. Werner and DeSimone (2012) described three primary functions of HRD that include: 1) training and development, 2) organizational development, and 3) career development. Many of the perceived areas of effectiveness and some challenges found in this study directly relate to these three tenets of the HRD discipline.

As discussed earlier in this document, the introduction of SAFe® brought with it a significant change from Waterfall in terms of structure, management practices, systems (policies and procedures), work climate (culture), task requirements, individual skills requirements, motivation, and individual and organizational values collectively resulting in changes in individual and organizational performance. These changes have direct implications on the aspects of HRD presented above and many others.

The study participants could not emphasize enough the importance of training at all levels. The change required a different type of training beyond job skills (i.e., a software developer would continue to develop software and a tester would continue to test). The training focused on "soft skills" that included the integration of the new method into the organization, assimilating the culture of self-organization, group facilitation, negotiation and conflict resolution skills. While the initial training was focused on the assimilation of the SAFe® method, additional training was provided for soft skills for some in key roles. The participants stated that one-time training alone is not enough and included on-going coaching and oversight to ensure the SAFe® framework was consistently applied to support the organization's success.

With the introduction of many new business and IT collaboration forums (e.g., PI

Planning, PO Sync, ART Sync, etc.), meeting and group facilitation skills gained new importance. Using Waterfall, the participants stated that there were very few interactions between the business and IT groups before the introduction of SAFe®. In addition to group facilitation techniques, the new interactions required IT resources to deliver technical concepts using business parlance versus "technospeak".

With the prioritization of new work occurring in two-week iterations, and emerging and often emergency changes being presented, negotiation and conflict resolutions skills are now at a premium. The Product Owner, RTE and Scrum Master need to leverage these skills among themselves and with a large stakeholder community.

The findings above underscore the need for HR in its strategic role to participate at the on-set of the decision to transition from Waterfall to SAFe®. HR needs a "seat at the table" when the decision to transition is first considered. As a strategic business partner, HR could leverage both their knowledge of the business and analytics capabilities to support cost benefit analyses, strategic risk assessments, organizational readiness reviews, skills assessments, training and development needs for both hard and soft skills and talent acquisition. If HR had participated in the strategy development phase, the organizations may have encountered fewer challenges described in this paper.

Recommendations for Practice

The findings from this study provide strong evidence in areas where the participants perceived SAFe® practices provide significant benefits to organizations across all areas of inquiry (see Table 17). The study participants described many efficiencies and improved processes in transitioning from Waterfall to SAFe® that included: increased the speed of delivery, risk reduction, increased productivity, enhanced software quality, lower rework,

reduced costs, enhanced product design, improved morale, enhanced collaboration, improved strategic alignment, increased customer satisfaction, improved visibility / transparency of progress, enhanced business agility, and simplified processes.

The study also uncovered some challenges to that would need to be addressed for organizations considering transitioning to SAFe® to achieve the aforementioned benefits (see Table 18). This section covers areas for organizations to consider as they transition to SAFe®.

Considerations for Transitioning to SAFe®

A number of challenges were also noted in the interviews. Across the areas of inquiry, several noteworthy common themes emerged across the data collection activities. Before transitioning to SAFe® organizations may be better positioned for success if they consider the strategies below.

Secure Management Commitment. Many participants noted the importance of having a senior executive serve as the program champion and sponsor. Participants stated that having someone at this level may help alleviate some of the "push back" encountered as described by those in this study. While the transition to SAFe® in all three cases started at the transactional (vs. transformational) level, the absence of executive support early on in one case followed it for some time, impacting the ability in some cases to gain consensus and acceptance which impeded flow and ultimately negatively impacted short-term performance.

Prepare for Organizational Change. Considering the participants in this study transitioned from Waterfall to SAFe®, the change rippled throughout the enterprise. The changes had an impact on the areas described in the Burke-Litwin model (2018) including management practices, structures, systems (policies and procedures), work climate, motivation, task requirements and individual skills, and individual needs ultimately resulting in individual and

organizational performance. Many study participants discussed the impact of transitioning to SAFe® as much more than changing the roles and tasks but changing the overall culture and mindset of those involved. It became apparent that the areas discussed above and the inter-relationships of each may not have been fully addressed when taking on this change.

Start Small and Gain Early Successes. Each of the teams started with small efforts and took the lessons learned from these activities and then expanded from there. Each organization had its own set of unique challenges and found that starting small gave an opportunity to work through issues without impacting the overall organization. One important note is that while starting small is preferred, management support is still needed even within a single team.

Provide SAFe® Training and Coaching. Training and on-going coaching were common themes with all those interviewed. One organization was concurrently balancing the need to train the team (and their client) and deploy SAFe® practices. Participants noted that training should not only include those on the team but should extend to other stakeholders with indirect involvement as well. Considering this was a significant departure from the earlier method, not only should training be provided, but many found that having a coach serve as the on-going process alignment champion on the team to help with questions and to oversee the processes were followed properly.

Understand SAFe® Culture. In addition to the list above, a central component of cultural change is that SAFe® espouses a Lean-Agile mindset. It was noted in the interviews that this is a critical aspect and recurring theme when using SAFe®. Taking an economic view, systems thinking, design thinking, and a DevOps approach were areas the respondents cited as critical success factors. The economic view considers a “best value” approach for the solutions being built. This includes risks, tradeoffs, cost of delay, and other factors of cost into the decision

making for features that will be prioritized for the next iteration. Systems thinking was described as considering the impact to the overall system versus just the new feature or component when prioritizing and aligning work. Systems thinking could therefore reduce the incidence of technical debt. Design thinking considers the customer and the creation of a usable product or solution. Several practices were cited to support this including User eXperience (UX) sessions with end users, customer surveys and prototype reviews with customers before development. A DevOps mindset encompasses communications and collaboration with all those involved in not only building but also those using, supporting, and maintaining the end product.

Embrace Team Empowerment. Moving from a centralized management structure (e.g., Waterfall) to a structure where teams are empowered to make "some decisions" on "how" to do the work, many reported resulted in greater team morale. However, this was also noted as one of the most difficult changes to implement. In order to achieve two-week iterations, timely decision making is critical. The governance model using SAFe® decentralizes certain decisions and requires the teams to share in these responsibilities to facilitate the two-week processes. One of the study participants shared that they were still having difficulty in some areas implementing decentralized decision-making and reducing the number of "gate reviews" within one of the Scrum teams. They found this impacted the workflow, ultimately reducing the amount of work the team produced. Considering that SAFe® provides significant transparency of the process, this should reduce the need for a series of management checkpoints.

Establish SAFe® Metrics. As described earlier, SAFe® uses *product-based* metrics, whereas Waterfall generally uses *project-based* based metrics. Participants described a difficulty in maintaining two sets of performance reports or trying to combine them to provide meaningful reports. The combination of management practices and processes require different measures.

One interviewee said trying to use Waterfall measures on SAFe® was like "saying I used to sell refrigerators, now I sell apples, how am I doing". When time and cost are fixed (two-week iterations and single team) and scope is the variable using SAFe® versus scope being fixed and time and cost are variables using Waterfall, it becomes easy to see the performance measures need to change in kind.

Assess Non-SAFe® Interactions. As organizations deploy SAFe®, a key challenge was the dependencies on other teams. Many cited the alignment of priorities and schedules with infrastructure teams as the greatest challenge. However, as software development teams' transition, there will be some that have and some that haven't yet transitioned. By organizing based on value streams or breaking down the work into independent work streams during the transition, the impact can be reduced or minimized.

Create SAFe® Contracts. Organizations need to consider reviewing existing contractual terms and potential changes required for SAFe® services. Two of the participant organizations discussed the need to consider contractual changes for third party systems integration organizations. Since priorities are reviewed prior to each two-week iteration, a fixed scope-based contract (like those used for Waterfall) would be difficult to administer considering it may require updates with each two-week iteration.

Apply Lessons Learned. Each of the participating organizations lauded SAFe® ceremonies of reviews and retrospectives supporting the need to make everyone aware of the success and challenges and to apply these lessons learned for continuous improvement. From a product perspective, the inspect and adapt (I&A) event provides an opportunity where the current state of the solution is demonstrated and reviewed by the team to discuss future innovations for "relentless" improvement. By providing continuous improvement practices for both the process

and the product, many found SAFe® effective in this area as long as the lessons learned were not only documented but acted upon.

Limitations of Research

In addition to the assumptions and limitations described in Chapter 1, additional limitations were realized during the study. At the beginning of the study, during the recruitment process, all 40 potential participant organizations were contacted, however, only three organizations agreed to participate. In all three cases, the organizations transitioned from Waterfall to SAFe®. This created an opportunity to cross compare the results across multiple organizations in different industries transitioning from Waterfall to SAFe®. This situation also presented an opportunity cost in that it did not provide an opportunity to compare and contrast efficiencies gained, or outcomes achieved by organizations transitioning from other methods or frameworks to SAFe®. Considering Waterfall is a very different from newer collaborative methods (e.g., Agile or Scaled Agile), the comparisons and results may have been impacted.

Limitations experienced during the study included the selection of individuals from within each participating organization. The research design required interactions with individuals from each organization in their respective SAFe® roles. Reflectively, the interviews were primarily with IT representatives or those in IT/business liaison roles. This condition may have led to an under-represented business perspective and the responses reflecting a more IT centric view. In addition, data collection and meeting participation was limited to those directly involved in the study (i.e., those who signed an Informed Consent form). The requirement to collect an Informed Consent form from each participant may have limited the ability to traverse the organization to elicit additional viewpoints.

Some representatives from the organizations voiced concerns about confidentiality of proprietary information, competitive information, progress tracking and all were concerned with data / internet security. These factors may have also played a role in limiting access to information presented to the researcher. For example, progress and trend information residing on internal tracking systems were discussed, however they were not shown, and no access was provided to verify the data. Because of the aforementioned conditions, the case study technique was not fully comprehensive in nature. This provided the researcher limited opportunities to verify their comments by comparing them to the management systems, observations in team meetings, or through additional participants.

For the online survey additional limitations may have existed. Due to the number of malware sites, some organizations were concerned about sharing a URL for the online survey. Each organization was asked to provide six participants for the online survey. A total of 18 surveys were initiated, however only 11 responses were found usable across all three organizations. Within the Qualtrics survey, for some responses after the participant agreed to participate, but Qualtrics recorded the questions were “not displayed to the respondent.” It is unclear why this condition was found. One person suggested it may be a firewall limitation in sharing data to the survey site. The combination of the concern about using external URLs and the condition with the survey tool may have impacted the response rate. This changed the opportunity to score each organization individually, resulting in only a collective score for all organizations.

A final limitation was observed when gathering data for the study and while writing the conclusions. Waterfall and SAFe® measure results very differently. The metrics discussed in the interviews regarding Waterfall were *project* management oriented. Measures of cost, scope,

schedule and earned value management were often cited. The measures used for SAFe® were conversely aligned with *product* management processes. Business value (through prioritization), velocity, working software and customer satisfaction were the primary measures cited by the participants. This made it difficult to compare the outcomes of the methods to determine which was more "successful" in common terms across the methods. In addition, velocity (in Agile and SAFe®) is a relative measure to the specific team based on that teams' performance. This limitation made direct correlations of output efficiencies more difficult to directly attribute within or among organizations. A final limitation is that two of the organizations transitioned over five years ago and baseline metrics were no longer available.

Recommendations for Future Research

Considering SAFe® and the other large-scale Agile methods and frameworks are emerging and continuing to evolve there are many opportunities for future research. As discussed in Chapter 1, research around the newer Large-Scale Agile software development methods is underway but relatively nascent. While independent individual case studies related to Large-Scale Agile methods have been published (Fitzgerald et al., 2013; Goh et al., 2013), many case studies regarding the effectiveness of various large-scale agile methods were conducted by the organizations that promote that associated method. Because of this, gaps remain in the literature in many areas. This section provides some considerations for future studies.

The current document researched the perceived effectiveness of the Scaled Agile Framework (SAFe®). This is, however, only one of several large-scale agile methods or frameworks in use today. Other popular frameworks include: Agile Portfolio Management (APM), Disciplined Agile Delivery (DAD), Enterprise Scrum, Large Scale Scrum (LeSS), Nexus^{TM}, and Recipes for Agile Governance in the Enterprise ^{SM} (RAGE). A similar study

regarding the perceived effectiveness of one of these methods may be considered using CAS theory as a lens for the study.

In the limitations section, two potential opportunities for future study were also noted: a business perspective and transitioning from another method to SAFe®. A similar study of only those in business roles may be conducted and this current study could be used as a comparator to understand if results were significantly different. Another potential study could be use of the same study, however, review organizations that transitioned from a method other than Waterfall to SAFe®. The current study could be used to compare and contrast the perceptions and findings of those transitioning from another method.

While this study presented findings on the perceived effectiveness of SAFe® at a point in time, additional studies may include either a longitudinal study or a study of the perceived effectiveness of specific practices within SAFe®. In a longitudinal study the researcher repeatedly examines the same organization to observe changes that may occur over a period of time. This would include conditions before SAFe®, during and after the transition to SAFe®. For SAFe® practices, a study of the perceived effectiveness of individual SAFe® configurations (i.e., Portfolio, Program, Large Solution) and/or practices could be conducted. Since SAFe® is a collection of multiple practices, this study could inform which practices participants perceive as providing the greatest contribution to the efficiencies gained and outcomes achieved. A table of potential factors impacting the perceived effectiveness is provided in Appendix D. This data is intended to potentially aid the future researcher directionally at the on-set of their study. The information in Appendix D is speculative in nature and would merit a full study to determine the attribution of the specific SAFe® practices on the efficiencies found in this study.

A final consideration for a future study is one that focuses on providing common measurements across various software development methods. This could help derive a taxonomy for comparing earlier methods with today's software development methods.

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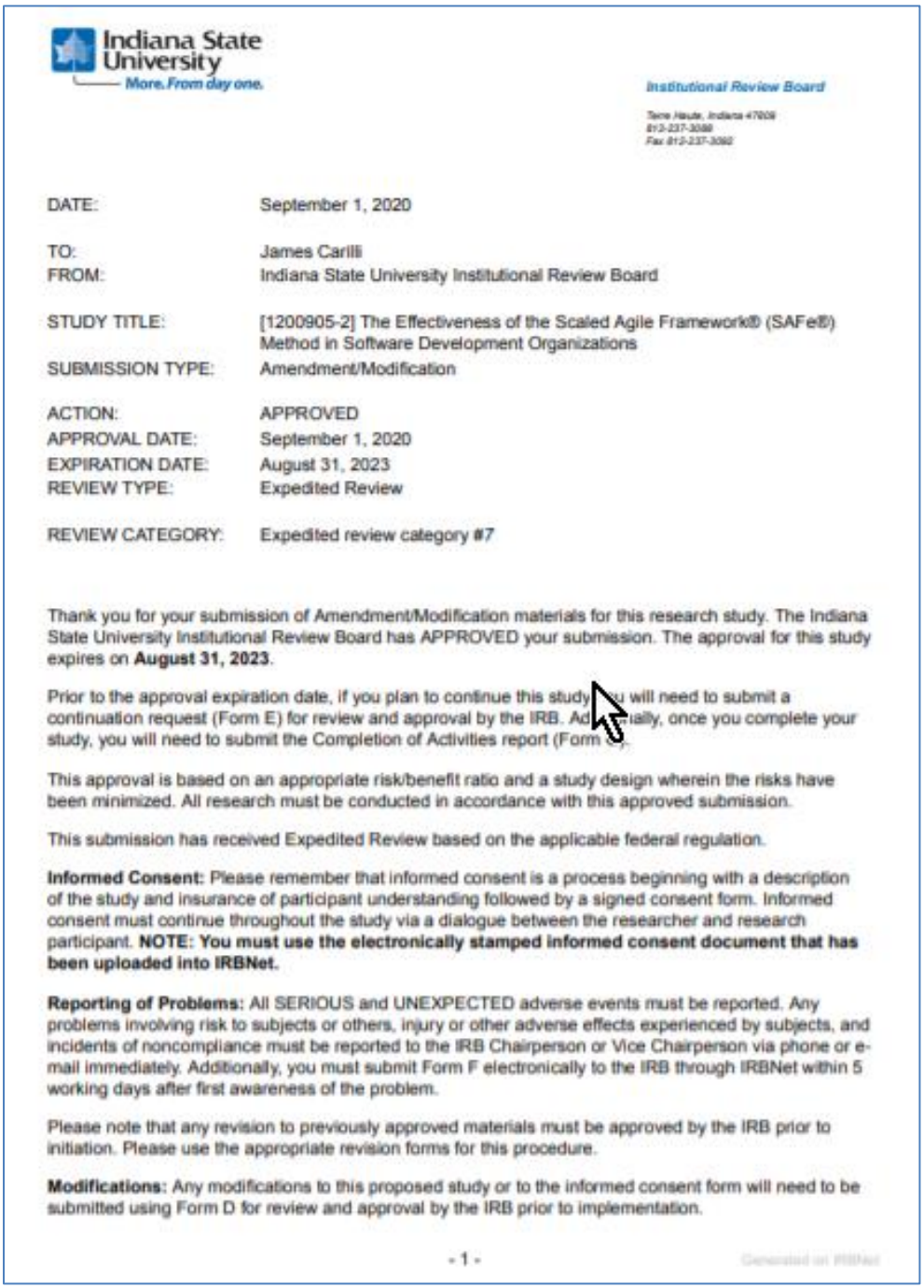
APPENDIX A: IRB Approval



Indiana State University
More. From day one.

Institutional Review Board

Terre Haute, Indiana 47809
812-237-3088
Fax 812-237-3092

DATE:	September 1, 2020
TO:	James Carlli
FROM:	Indiana State University Institutional Review Board
STUDY TITLE:	[1200905-2] The Effectiveness of the Scaled Agile Framework® (SAFe®) Method in Software Development Organizations
SUBMISSION TYPE:	Amendment/Modification
ACTION:	APPROVED
APPROVAL DATE:	September 1, 2020
EXPIRATION DATE:	August 31, 2023
REVIEW TYPE:	Expedited Review
REVIEW CATEGORY:	Expedited review category #7

Thank you for your submission of Amendment/Modification materials for this research study. The Indiana State University Institutional Review Board has APPROVED your submission. The approval for this study expires on **August 31, 2023**.

Prior to the approval expiration date, if you plan to continue this study, you will need to submit a continuation request (Form E) for review and approval by the IRB. Additionally, once you complete your study, you will need to submit the Completion of Activities report (Form C).

This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Informed Consent: Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. **NOTE: You must use the electronically stamped informed consent document that has been uploaded into IRBNet.**

Reporting of Problems: All SERIOUS and UNEXPECTED adverse events must be reported. Any problems involving risk to subjects or others, injury or other adverse effects experienced by subjects, and incidents of noncompliance must be reported to the IRB Chairperson or Vice Chairperson via phone or e-mail immediately. Additionally, you must submit Form F electronically to the IRB through IRBNet within 5 working days after first awareness of the problem.

Please note that any revision to previously approved materials must be approved by the IRB prior to initiation. Please use the appropriate revision forms for this procedure.

Modifications: Any modifications to this proposed study or to the informed consent form will need to be submitted using Form D for review and approval by the IRB prior to implementation.

- 1 -

Generated on IRBNet

Please note that all research records must be retained for a minimum of three years. If those research records involve health information, those records must be retained for a minimum of six years.

If you have any questions, please contact Dr. Ryan Donlan within IRBNet by clicking on the study title on the "My Projects" screen and the "Send Project Mail" button on the left side of the "New Project Message" screen. I wish you well in completing your study.

APPENDIX B: INTERVIEW INSTRUCTIONS AND INSTRUMENT

Qualitative Survey Instructions

Before proceeding with the survey, the participant will be provided the following information:

1) The purpose of the interview.
    a. The survey supports research I am conducting for a Ph.D. degree in Technology Management from Indiana State University. The purpose of this study is to investigate the extent of perceived effectiveness of the Scaled Agile Framework® in Software Development Organizations using Complex Adaptive Systems as a lens to guide the study.
2) The terms of confidentiality.
    a. Your participation is confidential. No one will be able to identify you or your answers, and no one will know whether you participated in the study. By completing and submitting your responses, you are voluntarily agreeing to participate. There are no anticipated risks, inconveniences, costs or benefits for your participation in this survey. You can withdraw at any time.
3) The format of the interview.
    a. The interview is comprised of open-ended questions.
4) How long the interview usually takes.
    a. It should take 30-45 minutes to complete.
5) On-line Survey
    a. I would also like to request you take a 20-question on-line survey. It should take less than 10 minutes to complete.
6) Contact information of the interviewer.
    a. My email address is jcarilli@indstate.edu or the Indiana State University Institutional Review Board (IRB) by phone at (812)-237-8217, or by email at isuirb@indstate.edu.
7) Discuss how information is captured
    a. I would like with your permission to record this session to ensure I correctly capture your input. However, if this makes you uncomfortable, I will just take notes.
8) Allow interviewee to clarify any doubts about the interview.
    a. Please let me know if you have any questions before we begin. If at any time you are uncomfortable with the questions or wish to end the interview I will respect your wishes.

Interviews, Observations and Interactions

Demographic Questions:

1. Can you provide your title?
2. What is your role in SAFe®?
3. How long have you been working with the SAFe®?
4. Do you have any SAFe® certifications?
5. Has the organization provided SAFe® training?
6. What level are your responsibilities are most closely aligned with? Portfolio, Program, or Team Level.

The following questions are related to the extent of perceived effectiveness of SAFe® in your organization using Complex Adaptive Systems as a lens to guide the study. This is not a review of your organization's effectiveness. In answering the following questions consider how SAFe® supports organizational efficiencies and outcomes for the areas in question. Please describe the benefits of SAFe® and any shortcomings in your responses.

RQ1a: Organizational Success Measures:

7. What were the business drivers your organization was trying to address by introducing SAFe®? (If unknown, what are the current business drivers?)
    a. Are the business drivers tracked today?
    b. Have you seen trends in either direction?
8. What are the key performance indicators used to measure organizational results?
    a. Have you seen trends in either direction since introducing SAFe®?
9. Are you using SAFe® practices to help you align with organizational strategies?
    a. Which SAFe® practices are you using? (Strategic Themes, Portfolio View, Portfolio Canvas, PI / Solution roadmap, Portfolio roadmap, Scrum of Scrums)
    b. (Based on answer) How does this practice(s) affect organizational efficiencies?
    c. (Based on answer) How does this practice(s) impact organizational outcomes?
    d. Which practices have the greatest effectiveness?

RQ1b: Self-Organized Team Management:

10. Do you use the concept of "self-organization" at this (Portfolio, Program, Team) level?
11. In using SAFe® practices, what are some of the benefits you've experienced in using self-organization at this level (i.e., Portfolio, Program, Team)?

12. In using SAFe® practices, what are some of the challenges you've experienced in using self-organization at this (i.e., Portfolio, Program, Team) level?

RQ1c: Stakeholder (Non-Linear Relationship) Management:

13. How does using SAFe® bring the voice of the customer into the software development process? (Portfolio Sync, ART Sync, Product Owner Sync, PI Planning, Solution Demos, Participatory Budgeting, Collaborative Scope and Schedule Management, Inspect and Adapt).
14. In using SAFe® practices, what are some of the benefits you've experienced in engaging stakeholders at this level (i.e., Portfolio, Program, Team)?
15. In using SAFe® practices, what are some of the challenges you've experienced in engaging stakeholders at this (i.e., Portfolio, Program, Team) level?

RQ1d: Emerging Requirements Management

16. What are the sources of the requirements (epics, features, stories) for the software products for your organization?
17. In using SAFe® practices, what are some of the benefits you've experienced in managing emerging requirements using SAFe® at this level (i.e., Portfolio, Program, Team)?
18. In using SAFe® practices, what are some of the challenges you've experienced in managing emerging requirements using SAFe® at this level?

RQ1: Overall Effectiveness of SAFe®.

19. In using SAFe®, where did you find the greatest efficiencies gained?
20. In using SAFe®, where did you find the greatest challenges that remain?
21. Was there anything that occurred that was unexpected when you transitioned to SAFe®?

Meetings and Document Reviews

I'd like to attend some meetings and review artifacts in support of this study.

- RQ1a: Management Systems – Measures and Metrics
- RQ1b: N/A
- RQ1c: Planning meetings (Portfolio Sync, ART Sync, Product Owner Sync, PI Planning, Solution Demos, Participatory Budgeting, Collaborative Scope and Schedule Management, Inspect and Adapt, Systems Demos, Process Meetings)
- RQ1d: Dependency Boards, Portfolio Kanban / Backlogs, Team Boards

Closing comments

I would like to reiterate that information collected today is only used for research purposes. All efforts will be made to keep your responses completely confidential. Do you have any questions regarding anything about this study before we close? Thank you so much for your participation. I truly appreciate your time.

APPENDIX C: SURVEY INSTRUCTIONS AND INSTRUMENT

Quantitative Survey Instructions

Before proceeding with the survey, the participant will be provided the following information:

The Effectiveness of the Scaled Agile Framework (SAFe®)
in Software Development Projects.

You are being invited to participate in a research study. The purpose of this study is to investigate the extent of perceived effectiveness of the Scaled Agile Framework (SAFe®) in software development organizations using Complex Adaptive Systems as a lens to guide the study. There are 20 questions in this study and it should take no more than 10 minutes to complete.

You might want to participant in this research is to support the understanding of the level of business agility in your organization. You may not want to participate may be due to not having the time to complete this survey or you be new to the organization.

The choice to participate or not is yours; participation is entirely voluntary. You may withdraw from the study at any time. Your participation is anonymous. No one will be able to identify you or your answers, and no one will know whether you participated in the study. There are no anticipated risks, inconveniences, costs or benefits for your participation in this survey.

The survey asks questions related to business agility in your organization. You have been asked to participate in this research because your input is important in helping characterize the current state of business agility in this organization.

If you have any questions about the study please contact me, Jim Carilli, at (703) 727-9969 or jcarilli@indstate.edu or you may contact the faculty sponsor, Dr. W. Tad Foster, at (812)230-9891 or tad.foster@indstate.edu.

If you have questions about your rights as a participant or if you feel you have been placed at risk you may contact the Indiana State University Institutional Review Board (IRB) by mail at Indiana State University, Office of Sponsored Programs, Terre Haute, IN 47809, by phone at (812) 237-3088 or by email at irb@indstate.edu.

Thank you for your time and consideration.

- ☐ I agree to the terms of my participation.
- ☐ I do not agree to the terms of my participation.

If the respondent selects “I do not agree…” they will be taken to the end of the survey.

The survey instrument used for this study is from “The agility factor: Building adaptable organizations for superior performance (First ed.),” by Worley, C. G., Williams, T., Lawler, E. E., 2014a, San Francisco, CA: Jossey-Bass. Copyright 2014 by Worley, C. G., Williams, T., Lawler, E. E. Adapted with permission.

Quantitative Survey Instrument

This set of statements are about your perception regarding the impact of Scaled Agile Framework® (SAFe) on organizational agility. For each question below, consider the business unit in which you use SAFe® and please select one answer for each question.

Q.	Our software development organization, using SAFe®…	Strongly Disagree	Disagree Somewhat	Agree Somewhat	Strongly Agree
1	…has a unifying purpose or mission other than profitability and growth	1	2	3	4
2	…spends a lot of time thinking about the future	1	2	3	4
3	…encourages innovation	1	2	3	4
4	…considers the ability to change a strength of the organization	1	2	3	4
5	…develops strategies with flexibility in mind	1	2	3	4
6	…puts as many employees as possible in contact with the external environment, especially with customers	1	2	3	4
7	…has enough budget "slack" so that people can develop new products or better ways of working together	1	2	3	4
8	…has a well-developed change capability	1	2	3	4
9	…has a culture that embraces change as normal	1	2	3	4
10	… allows information to flow freely from the outside to units and groups where it is most valuable	1	2	3	4
11	…has flexible budgets that respond to marketplace changes	1	2	3	4
12	…rewards seniority more than performance (note: reverse scoring)	4	3	2	1
13	…has core values that reflect a change-ready organization	1	2	3	4
14	…shares financial and business strategy information with all employees	1	2	3	4
15	…is capable of shifting its structure quickly to address new opportunities	1	2	3	4
16	…pays for skills and knowledge that contribute to performance	1	2	3	4
17	…regularly reviews learnings from change efforts	1	2	3	4
18	…has formal mechanisms to connect senior management with people at all levels of the organization	1	2	3	4
19	…encourages managers to develop the leadership skills of their direct reports	1	2	3	4

20. My responsibilities are most closely aligned at the:

Portfolio Level ☐ Program Level ☐ Team Level ☐

Thank you for participating in this study.

Survey Instrument Coding

The table below presents the coding used to derive scores for the on-line survey. Each question is aligned with one of four areas of consideration. The questions are of equal weight scored on a 4 point Likert-type scale with question number 12 reverse coded.

Q.	Using SAFe®, this organization…	Routine
1	…has a unifying purpose or mission other than profitability and growth	Dynamic Strategy
2	…spends a lot of time thinking about the future	Perceiving
3	…encourages innovation	Testing
4	…considers the ability to change a strength of the organization	Implementing
5	…develops strategies with flexibility in mind	Dynamic Strategy
6	…puts as many employees as possible in contact with the external environment, especially with customers	Perceiving
7	…has enough budget "slack" so that people can develop new products or better ways of working together	Testing
8	…has a well-developed change capability	Implementing
9	…has a culture that embraces change as normal	Dynamic Strategy
10	… allows information to flow freely from the outside to units and groups where it is most valuable	Perceiving
11	…has flexible budgets that respond to marketplace changes	Testing
12	…rewards seniority more than performance	Implementing
13	…has core values that reflect a change-ready organization	Dynamic Strategy
14	…shares financial and business strategy information with all employees	Perceiving
15	…is capable of shifting its structure quickly to address new opportunities	Testing
16	…pays for skills and knowledge that contribute to performance	Implementing
17	…regularly reviews learnings from change efforts	Testing
18	…has formal mechanisms to connect senior management with people at all levels of the organization	Perceiving
19	…encourages managers to develop the leadership skills of their direct reports	Implementing

The individual routine scores and overall score will be calculated for each organization. The same scores will be combined to represent the collective findings from all organizations studied.

APPENDIX D: POTENTIAL FACTORS IMPACTING SAFe® EFFICIENCIES

In the Recommendations for Future Research section presented in Chapter 5, a potential future study was discussed that would involve studying the perceived effectiveness of individual SAFe® configurations (i.e., Portfolio, Program, Large Solution) and/or SAFe® practices on the efficiencies found in this study. The future study could be used to determine the attribution of SAFe® configurations and/or practices on the efficiencies found in this study.

Table 19 presents the perceived efficiencies and/or benefits found in the current study and maps those to potential SAFe® practices that may have contributed to the findings. As described above, the data in the table below is speculative in nature and would require a full study to determine the attribution of the specific SAFe® practices on the efficiencies found in this study. This data is intended to potentially aid a future researcher directionally at the on-set of their study.

Table 19

Perceived Efficiencies Mapped to Potential Contributing SAFe® Practices

Research Question	Perceived Efficiency / Benefit	Potential Contributing SAFe® Practice
RQ1a: Organizational Outcomes	• Increased the speed of delivery/accelerated time to market and reduced risk through shorter development cycles	• Agile Release Train, Continuous Delivery Pipeline, Customer Centricity, Program Increment Planning, Iterations (based on Scrum XP or Team Kanban)
	• Increased productivity by focusing on high priority work	• Portfolio Vision, Portfolio Canvas, Portfolio Backlog, Portfolio Sync, Program Backlog, PI Planning, PO Sync, ART Sync, Team Events (Iteration Planning,

Research Question	Perceived Efficiency / Benefit	Potential Contributing SAFe® Practice
		Execution, Review, Retrospective, Backlog Refinement, etc.)
	• Enhanced software quality and lower rework complexity through design thinking and prototyping	• Design Thinking, Prototyping, System Demos, Inspect & Adapt Events
	• Reduced overall costs by applying Lean-Agile principles included in SAFe®	• Lean: Respect for people and culture, Flow, innovation, relentless improvement, value streams. • Agile mindset: Individual and interactions over process and tools, working software over comprehensive documentation, customer collaboration over contract negotiation, responding to change over following a plan.
	• Enhanced product design through UX, prototyping, and customer feedback cycles	• Prototyping, UX Deign, Design Thinking, System Demos, Inspect and Adapt, Customer Feedback
RQ1b: Self-Organization	• Improved team morale for both business and IT representatives	• Self-organization, Decentralized decision-making, Portfolio Sync, PO Sync, ART Sync, Prototypes, Demos.
	• Enhanced collaboration processes resulting in more inclusion of distributed teams	• PI Planning, System Demos, Inspect & Adapt, Scrum of Scrums, PO Sync, ART Sync, Team Events (Iteration Planning, Execution, Review, Retrospective, Backlog Refinement, etc.)
RQ1c: Non-Linearity Relationships	• Improved strategic alignment with business objectives through continuous prioritization.	• Portfolio Vision, Portfolio Canvas, Portfolio Backlog, Portfolio Sync, Program Backlog, PI Planning, PO Sync, ART Sync, Team Events (Iteration Planning, Execution, Review, Retrospective, Backlog Refinement, etc.)
	• Higher customer engagement resulting in increased customer satisfaction	• Portfolio Vision, Portfolio Canvas, Portfolio Backlog, Portfolio Sync, Program Backlog,

Research Question	Perceived Efficiency / Benefit	Potential Contributing SAFe® Practice
		PI Planning, PO Sync, ART Sync, Team Events (Iteration Planning, Execution, Review, Retrospective, Backlog Refinement, etc.)
	• Increased project/program visibility through dashboards that demonstrate work-in-progress is aligned with organizational priorities.	• Portfolio Vision, Portfolio Canvas, Portfolio Backlog, Portfolio Sync, Program Backlog, PI Planning, PO Sync, ART Sync, Team Events (Iteration Planning, Execution, Review, Retrospective, Backlog Refinement, etc.)
RQ1d: Emergence	• Enhanced the ability to manage changing priorities	• Program Backlog, PI Planning, PO Sync, ART Sync, Team Events (Iteration Planning, Execution, Review, Retrospective, Backlog Refinement, etc.)
	• Simplified software development processes	• Team Events (Iteration Planning, Execution, Review, Retrospective, Backlog Refinement, etc.)
RQ1e: Agility	• Increased business agility through shorter development cycles and ongoing prioritization	• Agile Release Train, Continuous Delivery Pipeline, Customer Centricity, Program Increment Planning, Iterations (based on Scrum XP or Team Kanban)

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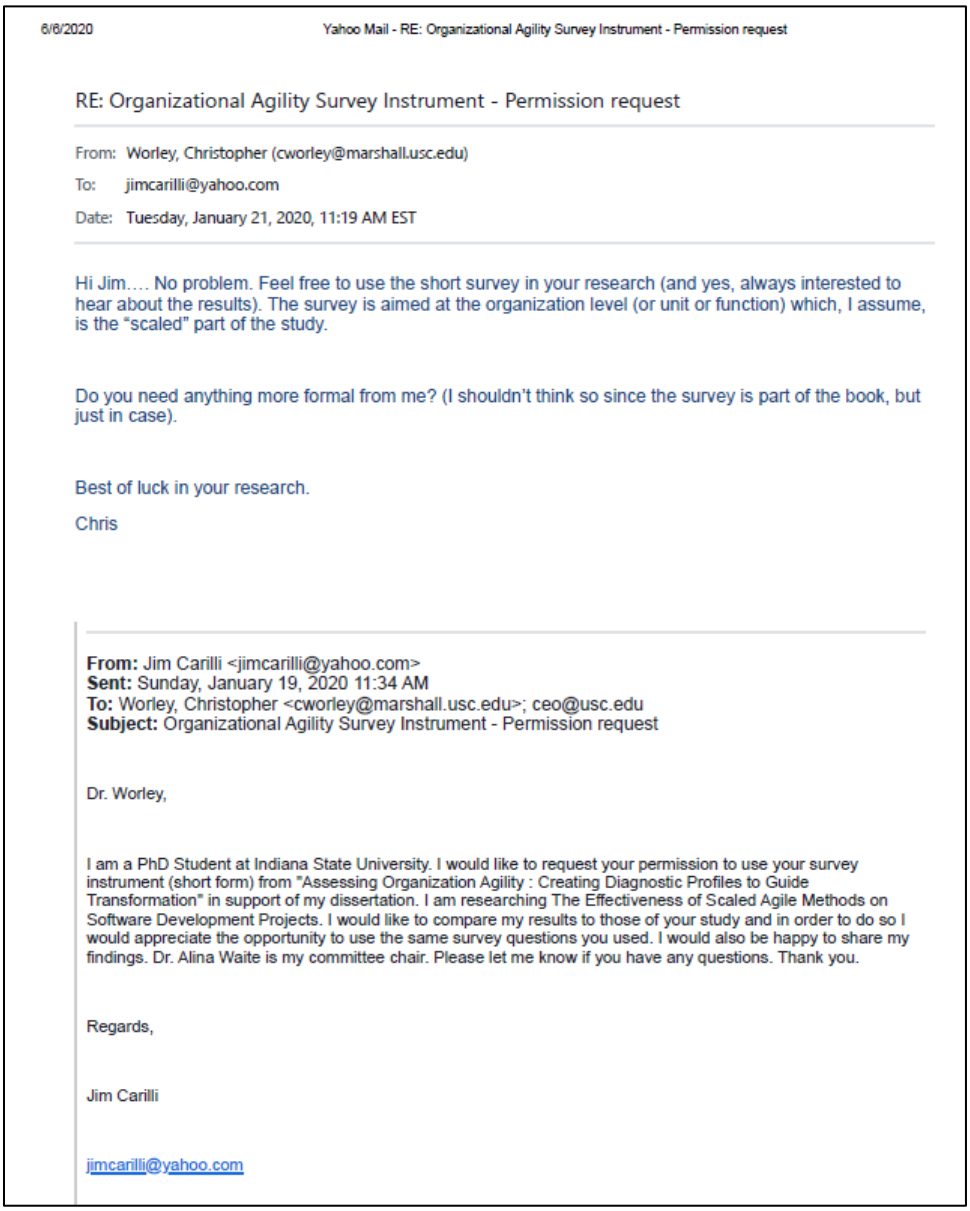
Worley, C. G., Williams, T., Lawler, E. E. & Ebook Central - Academic Complete. (2014b). *Assessing organization agility: Creating diagnostic Profiles to Guide transformation*. San Francisco, CA: Jossey-Bass.



6/6/2020 Yahoo Mail - RE: Organizational Agility Survey Instrument - Permission request

RE: Organizational Agility Survey Instrument - Permission request

From: Worley, Christopher (cworley@marshall.usc.edu)

To: jimcarilli@yahoo.com

Date: Tuesday, January 21, 2020, 11:19 AM EST

Hi Jim…. No problem. Feel free to use the short survey in your research (and yes, always interested to hear about the results). The survey is aimed at the organization level (or unit or function) which, I assume, is the "scaled" part of the study.

Do you need anything more formal from me? (I shouldn't think so since the survey is part of the book, but just in case).

Best of luck in your research.

Chris

From: Jim Carilli <jimcarilli@yahoo.com>
Sent: Sunday, January 19, 2020 11:34 AM
To: Worley, Christopher <cworley@marshall.usc.edu>; ceo@usc.edu
Subject: Organizational Agility Survey Instrument - Permission request

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Regards,

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jimcarilli@yahoo.com

Figure 1 Permission: Complex Adaptive Systems Theory

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Figure 2 Permission: Burke Litwin Model

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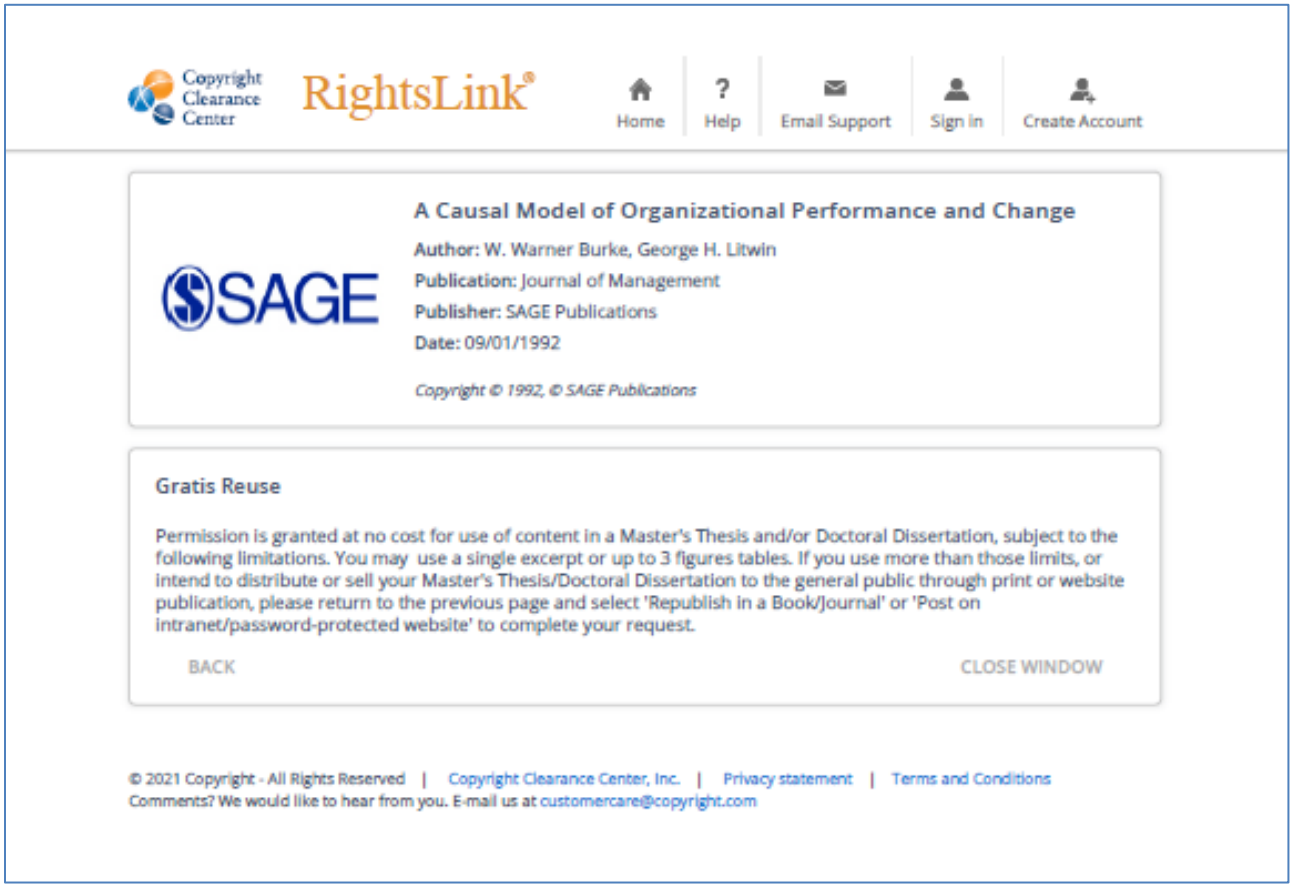
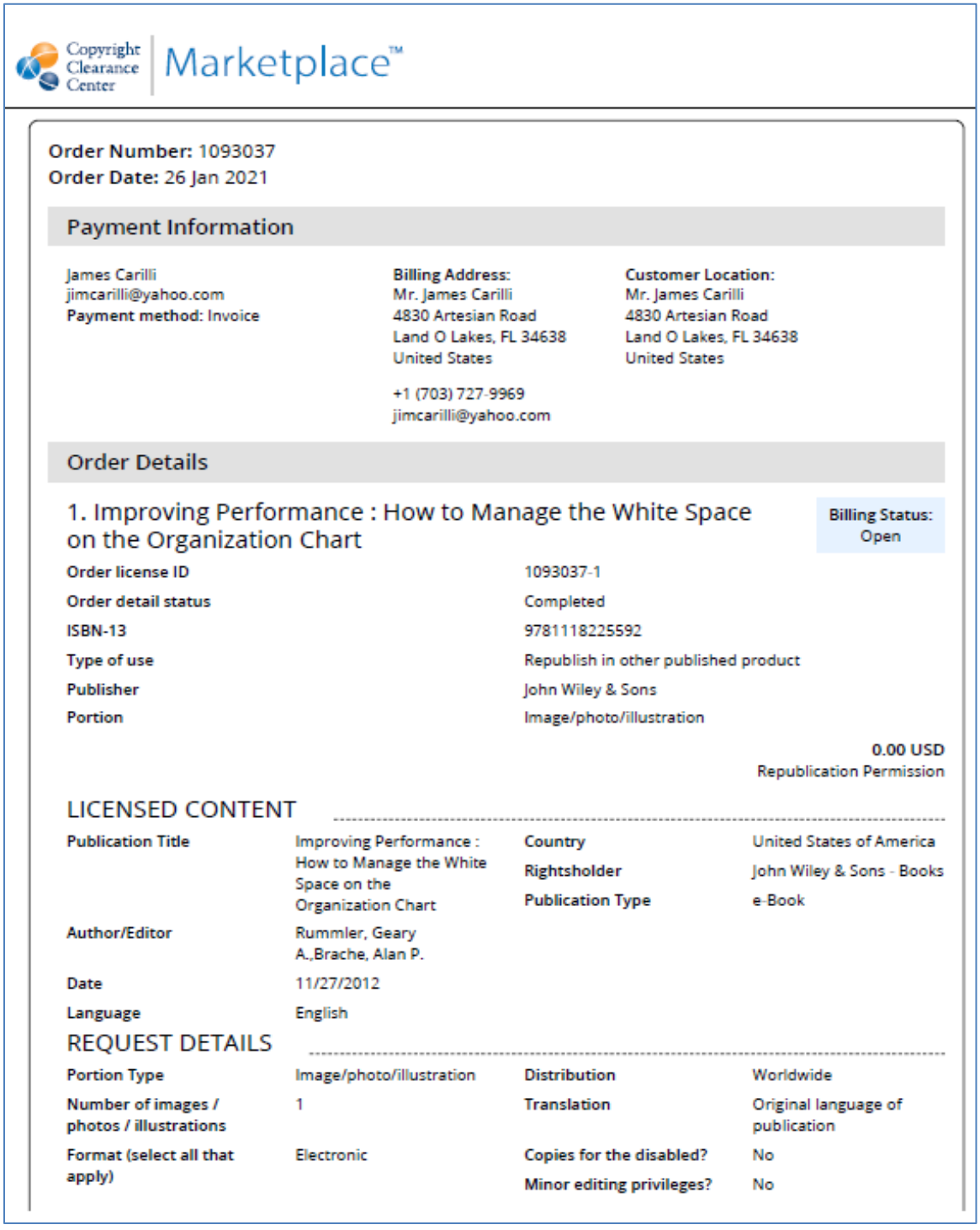


Figure 3 Permission: Rummler-Brache Nine Performance Variables Framework

Rummler, G. A. & Brache, A. P. (2013). *Improving performance: How to manage the white space on the organization chart.* John Wiley & Sons.



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		Expected publication date	2021-04-01
Author	James F Carilli		

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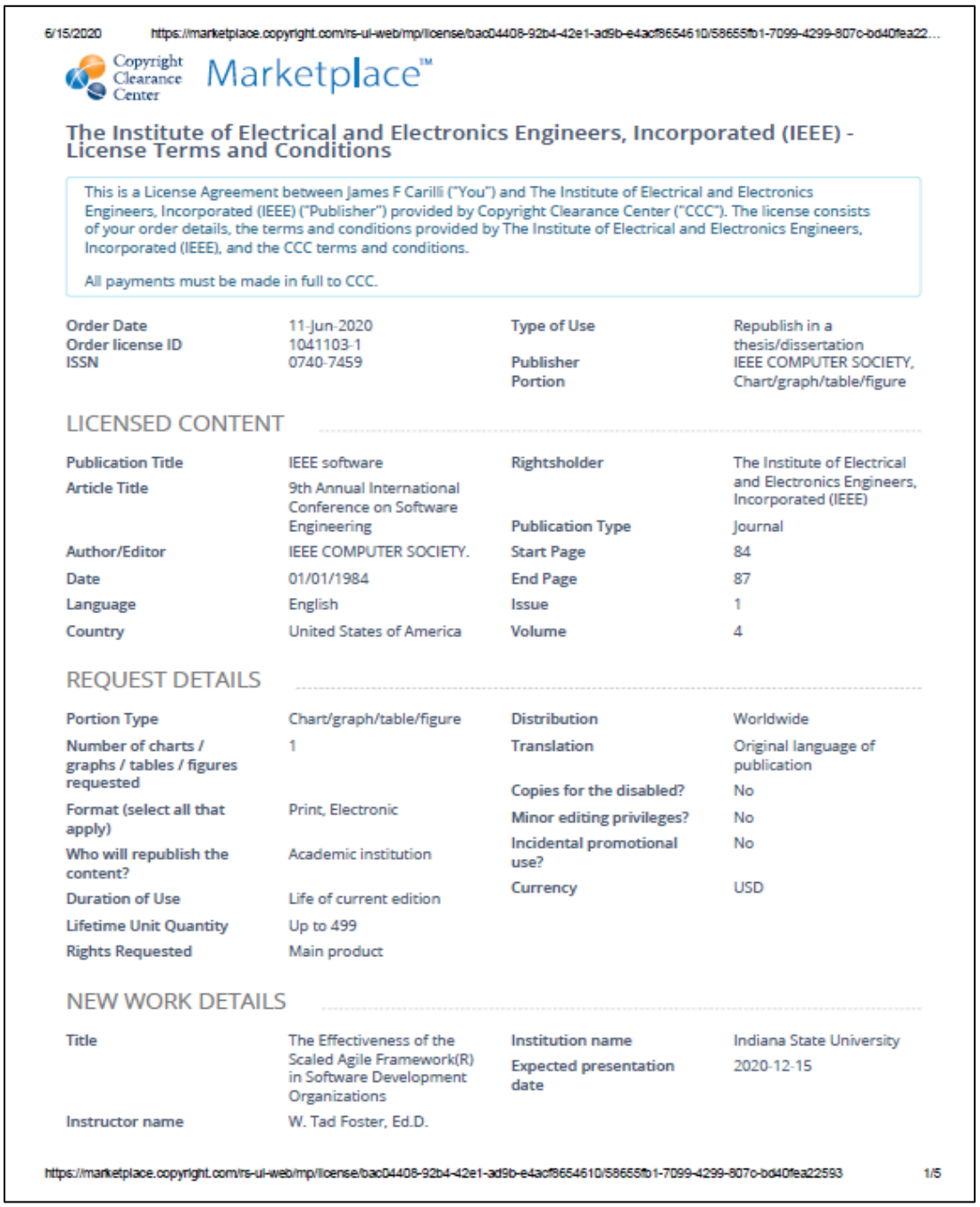

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Instructor name	W. Tad Foster, Ed.D.		

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jurisdiction covers the location of the Rightsholder set forth in the Order Confirmation. The parties expressly submit to the personal jurisdiction and venue of each such federal or state court.If you have any comments or questions about the Service or Copyright Clearance Center, please contact us at 978-750-8400 or send an e-mail to support@copyright.com.

v 1.1

Figure 5 Permission: Agile Values

Beck et al. (2001). *Manifesto for Agile software development*. Retrieved on August 8, 2020 from https://www.agilealliance.org/agile101/the-agile-manifesto/.

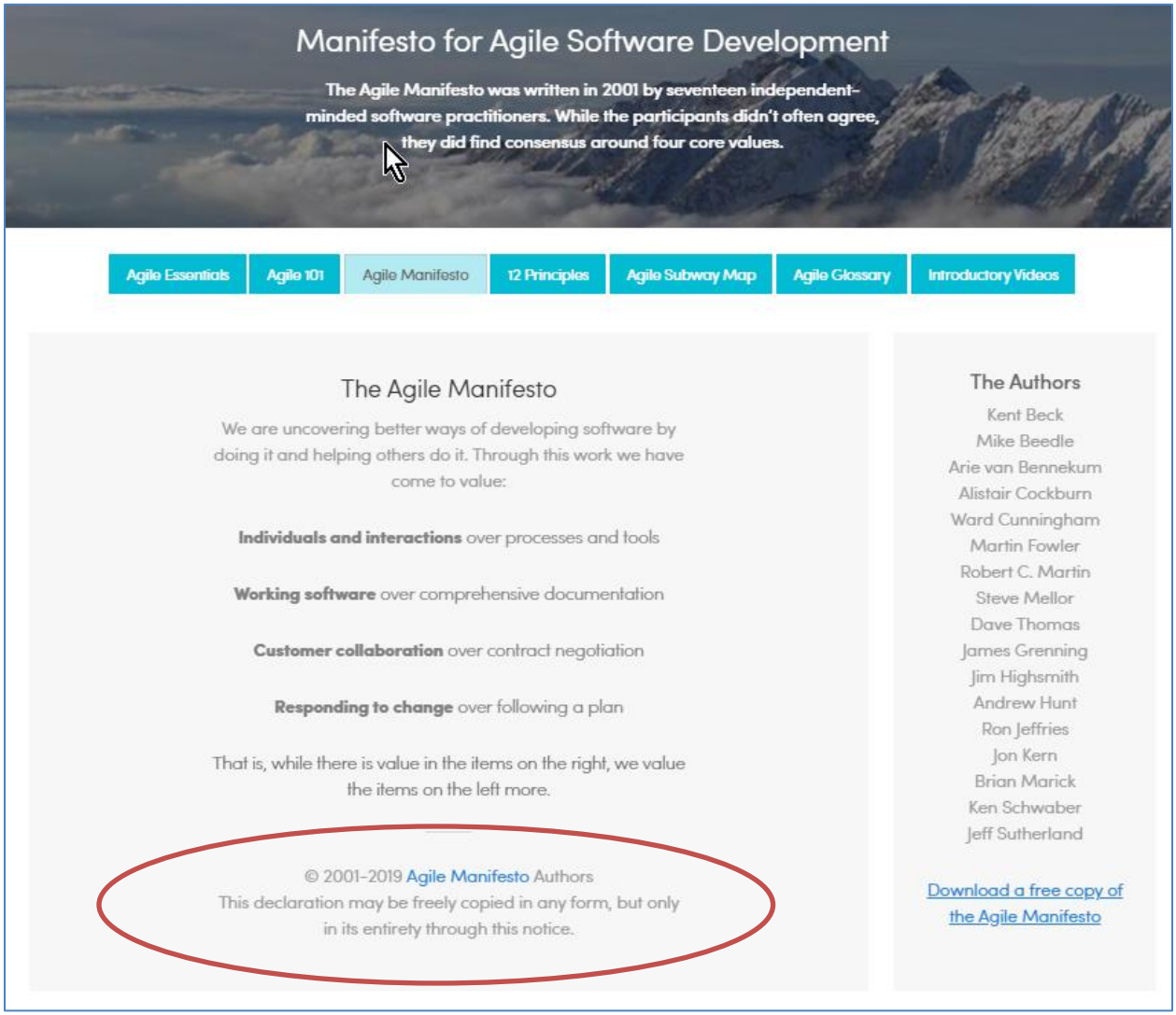
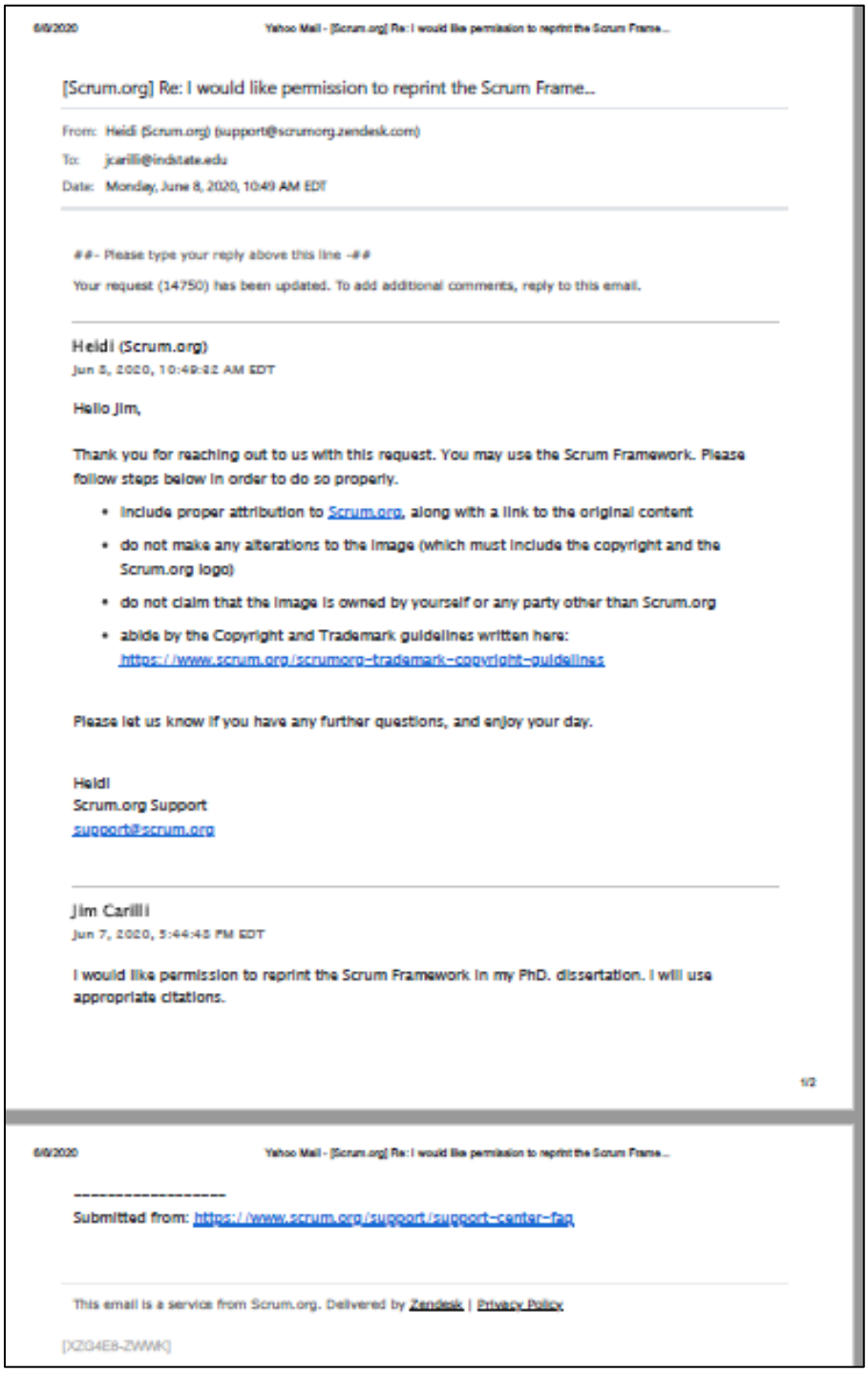


Figure 6 Permission: The Scrum Framework

Scrum.org. (2020). *The Scrum Framework*. Retrieved on January 20, 2020 from https://www.scrum.org/resources/scrum-framework-poster



6/8/2020 Yahoo Mail - [Scrum.org] Re: I would like permission to reprint the Scrum Frame...

[Scrum.org] Re: I would like permission to reprint the Scrum Frame...

From: Heidi (Scrum.org) (support@scrumorg.zendesk.com)
To: jcarilli@indstate.edu
Date: Monday, June 8, 2020, 10:49 AM EDT

##- Please type your reply above this line -##

Your request (14750) has been updated. To add additional comments, reply to this email.

Heidi (Scrum.org)
Jun 8, 2020, 10:49:32 AM EDT

Hello Jim,

Thank you for reaching out to us with this request. You may use the Scrum Framework. Please follow steps below in order to do so properly.

- include proper attribution to Scrum.org, along with a link to the original content
- do not make any alterations to the image (which must include the copyright and the Scrum.org logo)
- do not claim that the image is owned by yourself or any party other than Scrum.org
- abide by the Copyright and Trademark guidelines written here: https://www.scrum.org/scrumorg-trademark-copyright-guidelines

Please let us know if you have any further questions, and enjoy your day.

Heidi
Scrum.org Support
support@scrum.org

Jim Carilli
Jun 7, 2020, 5:44:48 PM EDT

I would like permission to reprint the Scrum Framework in my PhD. dissertation. I will use appropriate citations.

1/2

6/8/2020 Yahoo Mail - [Scrum.org] Re: I would like permission to reprint the Scrum Frame...

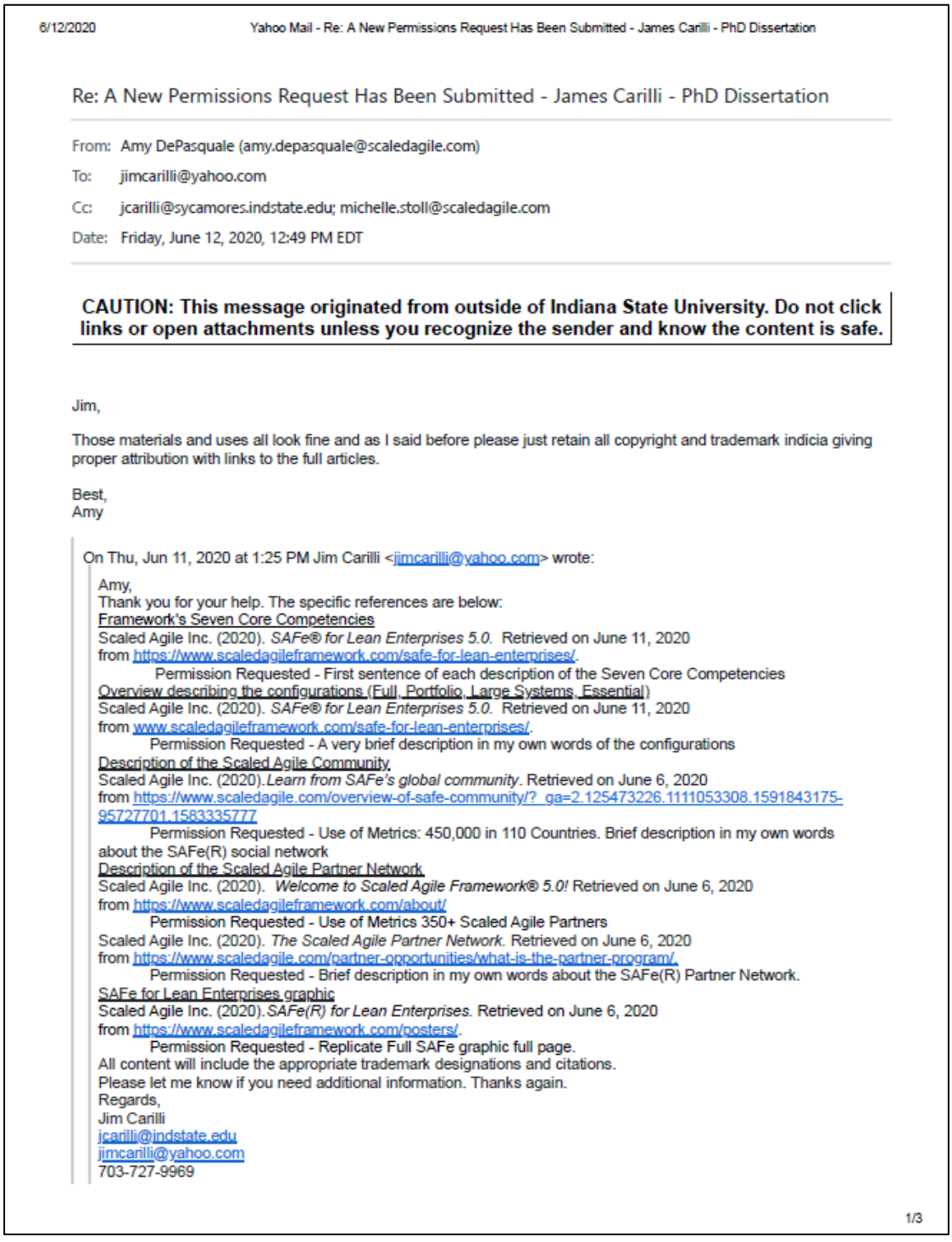
Submitted from: https://www.scrum.org/support/support-center-faq

This email is a service from Scrum.org. Delivered by Zendesk | Privacy Policy

[XZG4E8-ZWWK]

Figure 7 Permission: SAFe® for Lean Enterprises 5.0

Scaled Agile Inc. (2020c). *SAFe® for Lean Enterprises 5.0*. Retrieved on June 10, 2020 from https://www.scaledagileframework.com/posters/



6/12/2020 Yahoo Mail - Re: A New Permissions Request Has Been Submitted - James Carilli - PhD Dissertation

Re: A New Permissions Request Has Been Submitted - James Carilli - PhD Dissertation

From: Amy DePasquale (amy.depasquale@scaledagile.com)
To: jimcarilli@yahoo.com
Cc: jcarilli@sycamores.indstate.edu; michelle.stoll@scaledagile.com
Date: Friday, June 12, 2020, 12:49 PM EDT

CAUTION: This message originated from outside of Indiana State University. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Jim,

Those materials and uses all look fine and as I said before please just retain all copyright and trademark indicia giving proper attribution with links to the full articles.

Best,
Amy

On Thu, Jun 11, 2020 at 1:25 PM Jim Carilli <jimcarilli@yahoo.com> wrote:

Amy,
Thank you for your help. The specific references are below:
Framework's Seven Core Competencies
Scaled Agile Inc. (2020). *SAFe® for Lean Enterprises 5.0.* Retrieved on June 11, 2020 from https://www.scaledagileframework.com/safe-for-lean-enterprises/.
Permission Requested - First sentence of each description of the Seven Core Competencies
Overview describing the configurations (Full, Portfolio, Large Systems, Essential)
Scaled Agile Inc. (2020). *SAFe® for Lean Enterprises 5.0.* Retrieved on June 11, 2020 from www.scaledagileframework.com/safe-for-lean-enterprises/.
Permission Requested - A very brief description in my own words of the configurations
Description of the Scaled Agile Community
Scaled Agile Inc. (2020).*Learn from SAFe's global community*. Retrieved on June 6, 2020 from https://www.scaledagile.com/overview-of-safe-community/?_ga=2.125473226.1111053308.1591843175-95727701.1583335777
Permission Requested - Use of Metrics: 450,000 in 110 Countries. Brief description in my own words about the SAFe(R) social network
Description of the Scaled Agile Partner Network
Scaled Agile Inc. (2020). *Welcome to Scaled Agile Framework® 5.0!* Retrieved on June 6, 2020 from https://www.scaledagileframework.com/about/
Permission Requested - Use of Metrics 350+ Scaled Agile Partners
Scaled Agile Inc. (2020). *The Scaled Agile Partner Network.* Retrieved on June 6, 2020 from https://www.scaledagile.com/partner-opportunities/what-is-the-partner-program/.
Permission Requested - Brief description in my own words about the SAFe(R) Partner Network.
SAFe for Lean Enterprises graphic
Scaled Agile Inc. (2020).*SAFe(R) for Lean Enterprises.* Retrieved on June 6, 2020 from https://www.scaledagileframework.com/posters/.
Permission Requested - Replicate Full SAFe graphic full page.
All content will include the appropriate trademark designations and citations.
Please let me know if you need additional information. Thanks again.
Regards,
Jim Carilli
jcarilli@indstate.edu
jimcarilli@yahoo.com
703-727-9969

1/3

On Thursday, June 11, 2020, 01:18:06 PM EDT, Amy DePasquale <amy.depasquale@scaledagile.com> wrote:
Jim,
Can you please provide URLs of the articles which you plan to reference? Also, are you planning to provide a general overview in your own words or do you want to take any content directly from the articles?
Thank you for the additional information.
Best,
Amy DePasquale

On Wed, Jun 10, 2020 at 9:10 PM Jim Carilli <jimcarilli@yahoo.com> wrote:

> Amy,
> Thank you for your support. The supporting information for which I am also requesting permission includes the following:
> - An overview describing the Framework's Seven Core Competencies of the Lean Enterprise
> - An overview describing the configurations (Full, Portfolio, Large Systems, Essential).
> - A description of the Scaled Agile Community and Scaled Agile Partner Network.
> All content in my dissertation will include the appropriate trademark designations and citations.
> Please let me know if you need additional information. Thanks again.
> Regards,
> Jim Carilli
> jcarilli@jndstate.edu
> jimcarilli@yahoo.com
> 703-727-9969
>
> On Wednesday, June 10, 2020, 03:04:02 PM EDT, Amy DePasquale <amy.depasquale@scaledagile.com> wrote:
>
> Hello James,
>
> Thank you for your permission request and interest in the Scaled Agile Framework® (SAFe®), the world's leading framework for business agility.
>
> You have permission to use the Safe for Lean Enterprises graphic provided you download it from this link - https://www.scaledagileframework.com/posters/ and make sure to retain all copyright and trademark indicia as well as follow the usage restrictions noted at the bottom of that web page under "The Fine Print." As far as using any "supporting information" I would need to know what information you refer to in order to provide guidance on that.
>
> Please let me know if you have any questions.
>
> Best,
> Amy DePasquale
> Legal Counsel
> ScaledAgile, Inc.
>
> ---------- Forwarded message ---------
> From: **Scaled Agile Community** <donotreply@scaledagile.com>
> Date: Tue, Jun 9, 2020 at 11:56 AM
> Subject: A New Permissions Request Has Been Submitted
> To: patrick.bates@scaledagile.com <patrick.bates@scaledagile.com>, michelle.stoll@scaledagile.com <michelle.stoll@scaledagile.com>, amy.depasquale@scaledagile.com <amy.depasquale@scaledagile.com>
>
> A new permissions request was submitted.
>
> Form Information:

Name: James Carilli

Email: jcarilli@indstate.edu

Company: Indiana State University

Detailed Description of text, graphic, doc, or publication: SAFe® for Lean Enterprises 5.0 overall graphic and supporting information regarding practices

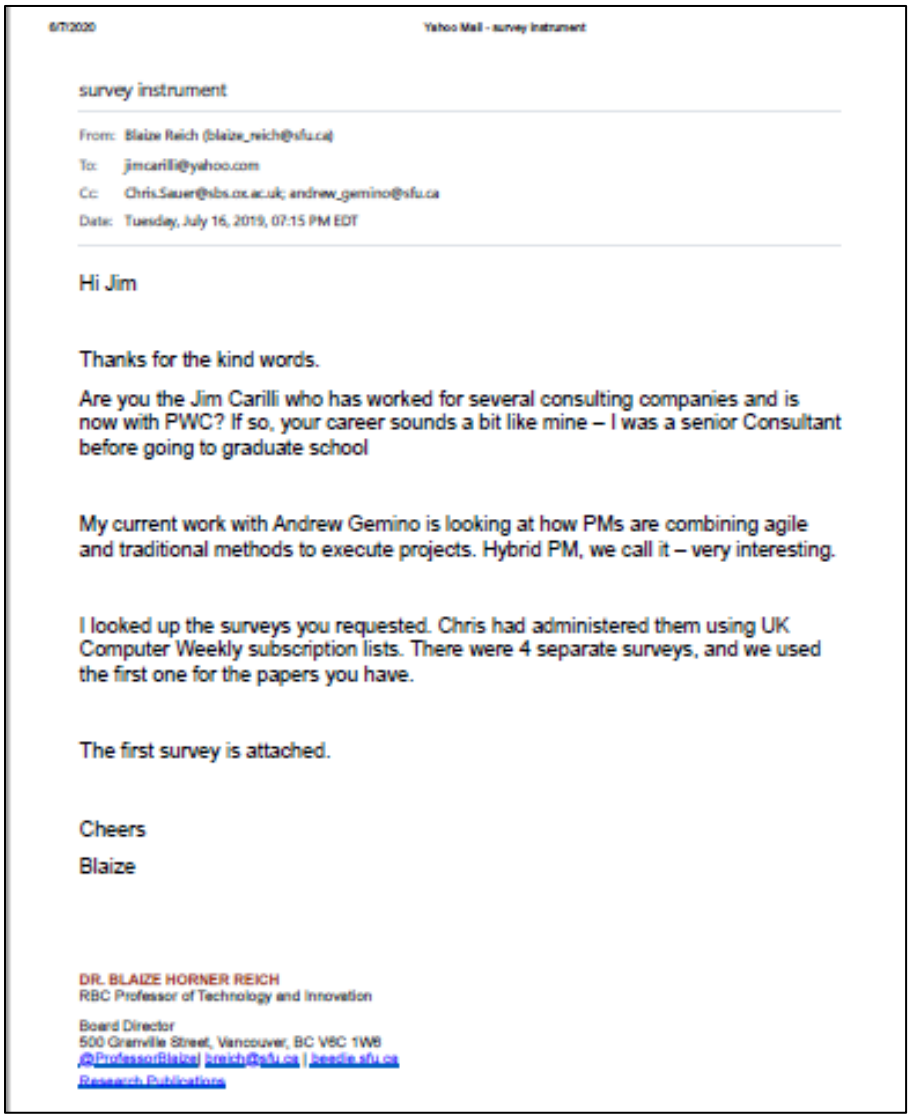
Intended use of the requested content: The graphic and supporting content will be used in my PhD Dissertation regarding the effectiveness of scaled agile practices. All content will include the appropriate trademark designations and citations.

You can also view the case in Salesforce Here: https://scaledagile.my.salesforce.com/500[illegible]00001dAkKJ

Figure 8 Permission: Project Resolution Coding

Gemino, A., Sauer, C. & Reich, B. (2007). Beyond chaos: Examining IT project performance. In *Proceedings of the 2nd International Research Workshop on Information Technology Project Management (IRWITPM)*, Montréal, Québec, Canada (p. 34).

Note: The graphic is a representation of the survey instrument approved below.



6/7/2020 Yahoo Mail - survey instrument

survey instrument

From: Blaize Reich (blaize_reich@sfu.ca)
To: jimcarilli@yahoo.com
Cc: Chris.Sauer@sbs.ox.ac.uk; andrew_gemino@sfu.ca
Date: Tuesday, July 16, 2019, 07:15 PM EDT

Hi Jim

Thanks for the kind words.

Are you the Jim Carilli who has worked for several consulting companies and is now with PWC? If so, your career sounds a bit like mine – I was a senior Consultant before going to graduate school

My current work with Andrew Gemino is looking at how PMs are combining agile and traditional methods to execute projects. Hybrid PM, we call it – very interesting.

I looked up the surveys you requested. Chris had administered them using UK Computer Weekly subscription lists. There were 4 separate surveys, and we used the first one for the papers you have.

The first survey is attached.

Cheers

Blaize

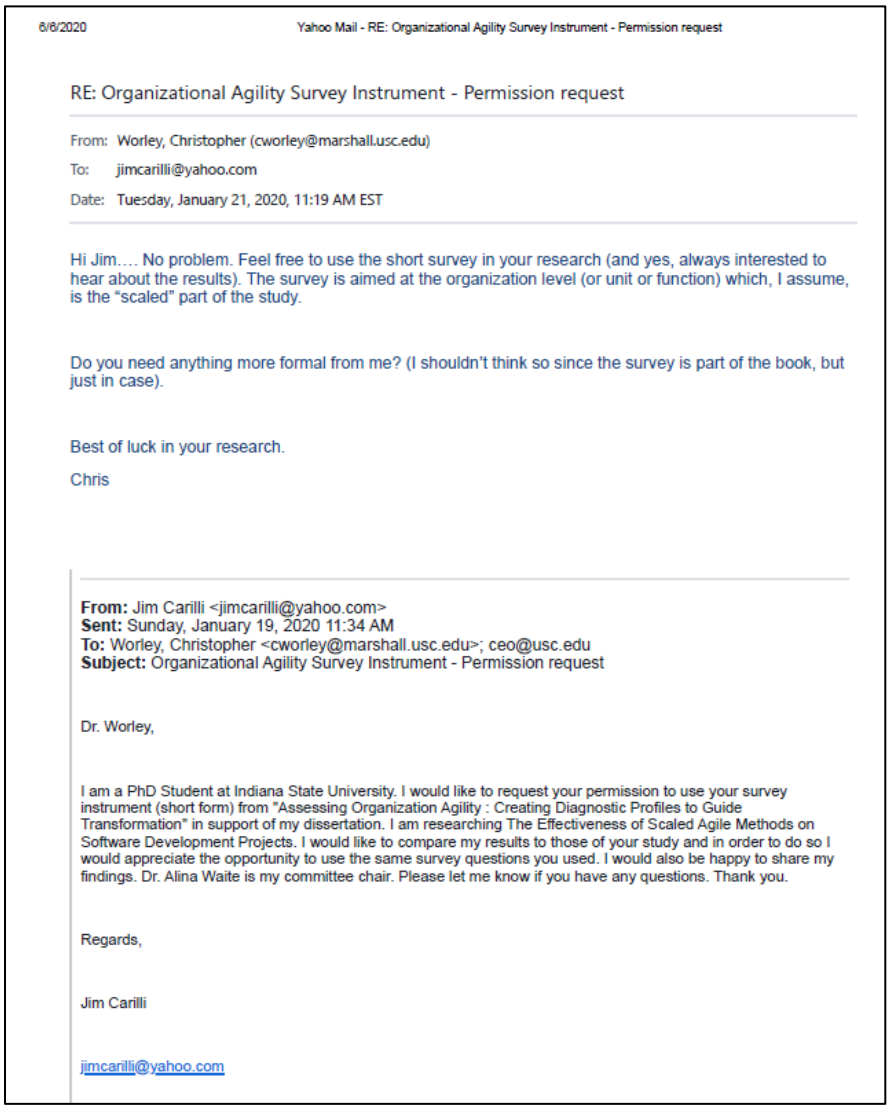
DR. BLAIZE HORNER REICH
RBC Professor of Technology and Innovation

Board Director
500 Granville Street, Vancouver, BC V6C 1W6
@ProfessorBlaize| breich@sfu.ca | beedie.sfu.ca
Research Publications

Figure 9 Permission: Organizational Agility Variables

Worley, C. G., Williams, T., Lawler, E. E. (2014b). *Assessing organization agility: Creating diagnostic Profiles to Guide transformation*. San Francisco, CA: Jossey-Bass.

Note: The graphic is a representation of the survey instrument approved below.



6/6/2020 Yahoo Mail - RE: Organizational Agility Survey Instrument - Permission request

RE: Organizational Agility Survey Instrument - Permission request

From: Worley, Christopher (cworley@marshall.usc.edu)
To: jimcarilli@yahoo.com
Date: Tuesday, January 21, 2020, 11:19 AM EST

Hi Jim…. No problem. Feel free to use the short survey in your research (and yes, always interested to hear about the results). The survey is aimed at the organization level (or unit or function) which, I assume, is the "scaled" part of the study.

Do you need anything more formal from me? (I shouldn't think so since the survey is part of the book, but just in case).

Best of luck in your research.

Chris

From: Jim Carilli <jimcarilli@yahoo.com>
Sent: Sunday, January 19, 2020 11:34 AM
To: Worley, Christopher <cworley@marshall.usc.edu>; ceo@usc.edu
Subject: Organizational Agility Survey Instrument - Permission request

Dr. Worley,

I am a PhD Student at Indiana State University. I would like to request your permission to use your survey instrument (short form) from "Assessing Organization Agility : Creating Diagnostic Profiles to Guide Transformation" in support of my dissertation. I am researching The Effectiveness of Scaled Agile Methods on Software Development Projects. I would like to compare my results to those of your study and in order to do so I would appreciate the opportunity to use the same survey questions you used. I would also be happy to share my findings. Dr. Alina Waite is my committee chair. Please let me know if you have any questions. Thank you.

Regards,

Jim Carilli

jimcarilli@yahoo.com

Figure 10 Permission: SAFe® as a CAS has multiple interrelated variables

Original work, no permission required.

Figure 11 Permission: Aggregate Organizational Agility Scores

Original work, no permission required.