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Should Agile be Part of Your Quality Management System?

Timothy C. Krehbiel
Miami University, krehbitc@miamioh.edu

Dana P. Miller
Miami University, mille704@miamioh.edu

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Timothy C. Krehbiel
Miami University
krehbitc@miamioh.edu

Dana P. Miller
Miami University

ABSTRACT

Purpose: The purpose of this paper is to explore the role of Agile in Quality Management Systems.

Design/methodology/approach: This paper provides a brief history of Agile and compares it to the management theory of W. Edwards Deming. The authors then examine the strengths and weaknesses of Lean, Agile, and Six Sigma in relationship to the four components of Deming's System of Profound Knowledge in order to clarify Agile's role in contemporary Quality Management Systems. In addition to the existing literature, the authors draw extensively on their experiences and observations from more than 50 years of experience in IT and quality (both as practitioners and academics) to substantiate the opinions expressed in the paper.

Findings: This paper acknowledges that while Deming's management theory could be accurately described as "agile," Agile is not comprehensive enough to be considered an effective stand-alone Quality Management System. However, our analysis suggests that Agile can be an important part of a contingency or umbrella approach to Quality Management.

Limitations: This is a very theoretical paper based on the authors' experiences and the existing literature. The next stage of this research is to conduct empirical studies in existing organizations to quantify the advantages and roadblocks of incorporating Agile methodologies in Quality Management Systems.

Originality/value: This paper helps to fill a void in the academic literature concerning the relationships between Agile and Deming's management theory.

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Moreover, using the System of Profound Knowledge to understand the role of Lean, Six Sigma and Agile in a Quality Management System is a novel approach.

KEYWORDS: Agile, Lean, Six Sigma, Deming, System of Profound Knowledge

INTRODUCTION

According to the American Society for Quality (2007), a Quality Management System (QMS) is the formalized system that documents the structure, responsibilities and procedures required to achieve effective quality management. Quality Management (QM) is the application of a QMS to achieve maximum customer satisfaction at the lowest overall cost to the organization while continuing to improve the process. Evans and Lindsay (2014, page 78) note that "a quality management system represents a specific implementation of quality concepts, standards, methods and tolls, and is unique to an organization." This uniqueness to a particular organization is referred to as a contingency approach to QM (Foster, 2017; Lagrosen and Lagrosen, 2003; Lagrosen *et al*., 2012) and draws from the contingency theory of management, which argues that the fit of organizational characteristics to the current contingencies in which the organization operates reveals how well the organization performs (Donaldson, 2001). These contingencies, or factors, include organizational strategy (Chandler, 1962), organizational size (Child, 1975) and the environment (Burns and Stalker, 1961). In addition to these factors, a contingency approach to QM also depends on organizational-level contingencies such as the sector within which the organization operates, the technical sophistication of the organization's employees, the degree to which a quality culture exists within the organization, and project-specific contingencies that recognize the continuum of methodologies an organization can apply to various projects. Frequently, an organization's QMS contains tools from various improvement methodologies (for example, see Gershon, 2010). Morris (2012) suggests that combining methodologies can lead to better outcomes.

To explore the role of Agile in a modern QMS, this paper presents a brief history of Agile and then provides a brief description of Deming's philosophy, exploring whether Deming's management system reflected elements of Agile and comparing Agile to Lean. We subsequently present an innovative approach to combining Lean and Agile, and use a framework provided by Deming's System of Profound Knowledge to propose that a combination of tools and thinking can be an optimal approach to defining, building and implementing a QMS. Finally, we reinforce the importance of taking a systems view towards QM.

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AGILE

The term Agile comes from the Agile Manifesto (see Figure 1), which was written at Snowbird, Utah, in 2001 by a gathering of software developers looking to write better software (AgileManifesto.org, 2001). The meeting's impetus was a reaction to the contract driven requirement delivery of earlier generations of software development, often called "waterfall". The waterfall model, which limits customer interaction and requirement gathering to the front end of the software-development process, often culminates in a disappointing unveiling of a new product or service at the back end. The Agile Way of Working (or Agile) is a collection of principles and practices that supports rapid and flexible response to change.

Figure 1: Agile Manifesto

Manifesto for Agile Software Development

We are uncovering better ways of developing
software by doing it and helping others do it.
Through this work we have come to value:

Individuals and interactions over processes and tools
Working software over comprehensive documentation
Customer collaboration over contract negotiation
Responding to change over following a plan

That is, while there is value in the items on
the right, we value the items on the left more.

Kent Beck	James Grenning	Robert C. Martin
Mike Beedle	Jim Highsmith	Steve Mellor
Arie van Bennekum	Andrew Hunt	Ken Schwaber
Alistair Cockburn	Ron Jeffries	Jeff Sutherland
Ward Cunningham	Jon Kern	Dave Thomas
Martin Fowler	Brian Marick	

The top four success measures for organizations using Agile are on-time delivery, business value, customer satisfaction, and product quality (Versionone.com, 2017), thus firmly establishing Agile as a legitimate approach to improving and managing quality. Agile attempts to bring value to the customer in smaller but more frequent intervals by promoting communication, collaboration, continuous improvement and reflection within teams of problem solvers. Agile also fosters self-managed teams by embracing changing requirements, delivering products frequently, using human-centric methods such as product owner representation, daily stand-up meetings, and personal accountability to the team. All these methods put people face-to-face rather than talking through screens. Agile practices heavily emphasize articulating goals, facilitating interactions, improving team dynamics, supporting collaboration and encouraging experimentation and innovation (Smith and Sidky, 2009).

From 2000-2010 Agile gained traction in the software development industry. However, Dyba and Dingsoyr (2008), and Middleton and Joyce (2012) both noted a lack of hard empirical evidence regarding the adoption and success of Agile. A study of nine industry surveys published in 2011 and 2012 on the rates of Agile methods usage found that although the surveys are mostly non-scientific, indicators suggest that Agile is growing and has moved into the mainstream (Stavru, 2014). These signifiers include: (1) the increasing number of scientific publications and specialized conferences; (2) the significant body of professional literature exploring Agile; (3) a large number of active professional communities consisting of individuals interested in Agile; and (4) the increasing number of success stories from large corporations using Agile, including IBM, Microsoft, SAP, Google, Apple, Cisco Systems, etc. More recently, Schur (2015) reported the adoption rate in software companies to be 94%, with 53% of the adopting organizations indicating that a majority of their Agile projects had succeeded. Versionone.com (2017) and Scrum Alliance (2018) reported accelerated growth in the number of organizations using Agile with increasing numbers of success. Agile's project management tools have also been used to help facilitate Six Sigma projects (Anderson, 2004; Parthasarathy and Rangarajan, 2008), non-software enterprise projects (Vandersluis, 2014) and big-data/analytics projects (Jones-Farmer and Krehbiel, 2016). Still, the lack of hard data on both the use and success of Agile persists. While aspects of Agile are present within current business practice and research, Agile is currently "not a precise business management paradigm relevant

in all fields of practice" (Crisan *et al.*, 2015, p.62). Organizations exist on a continuum of Agile maturity due to the nature of
their business focus, age, and culture which may account for the lack of definition of success or failure in adoption of Agile methods.

The rising and continued use of Agile corresponds with the dramatic technological changes in our economy. Younger companies and start-ups are better poised to adopt Agile methods than older organization such as the military, higher education or large corporations, which are often siloed in functional areas (i.e., individuals or groups within a particular functional area do not want to share information or knowledge with others outside their "silo" even though they are in the same organization), and extremely risk adverse and resistant to change. An Amazon employee who started working there in 1997, the year the company became publicly traded, said there was no adoption of Agile at the company because Amazon had always been using Agile methods (personal communication, April, 16, 2014).

Amazon clearly understood the rapid customer feedback mechanism of the Internet necessitated the build-out of Agile capabilities to adjust quickly and views itself as a technology company where the IT backbone is infused throughout the organization to support experimentation in products and services rather than housing a distinct and separate IT department. Gray (2014) noted elements of the Deming philosophy in the experimental nature of Amazon's efforts. For example, in building out the Amazon marketplace, Amazon put in place the infrastructure to offer Amazon Web Services that are now a significant portion of earnings for the company and an example of scaling up a successful experiment.

DEMING PHILOSOPHY

With increasing intensity since the end of World War II, quality management frameworks have spread from manufacturing into service sectors such as sales, marketing and customer service, and more recently, into healthcare, K-12 education and higher education. Because of the evolutionary rather than revolutionary nature of quality, QM and QMS, a discussion of future practice requires an informed review of their histories.

The modern era of QM associated with manufacturing is thought to originate with Walter Shewhart's statistical quality control work at Western Electric in Chicago in the 1920s and continue with the influence of W. Edwards Deming and Joseph Juran on both the U.S. wartime economy in the 1940s and their subsequent

influence of the post-war economy of Japan. The rise of quality and manufacturing competition in the post-war Japanese economy produced a delayed embrace of modern QM by U.S. industry in the 1980s. QM in the United States took on many forms in the 1980s, including TQM, Six-Sigma and the Malcolm Baldrige National Quality Award. QM was further codified in the 1990s with the term Lean. The Toyota Production System is possibly the closest an organization has come to implementing and refining Deming's theories. Arising from the manufacturing world, the most prominent and enduring form of QMS today is Lean Six Sigma, a combination of the tools and mindsets from Lean and Six Sigma (Antony *et al.* 2017). Lean and Lean Six Sigma started to make the move into the service industries in the late 90's and early 2000's. The basis of our service industry is software development and here is the area where we start to see the connection of Agile with Deming's ideas.

Deming (1982, 1985) challenged current management practices in the 1980s. Table 1 presents his 14 Points for Management, providing the groundwork for his theory of management. Conklin (2014) provides a contemporary interpretation of Deming's 14 Points and underscores the important underlying principles of putting the customer first, quality being everyone's job, building quality into designs and processes, and the need for solving the root causes of problems and continual improvement. Deming's theory was coined Total Quality Management (TQM), and business, education, military and government organizations jumped on the TQM bandwagon. It is important to understand the value Deming placed upon the precise meaning of words by looking at his own words describing how he felt about how leadership's lack of a systems view in the modern workplace created a sub-optimized and inhumane environment that devalued cooperation and collaboration which are values re-surfaced and re-packaged by Agile. Deming believed most business reengineering or process improvement efforts were superficial, lacked leadership buy in, and did not have a systems perspective. Here is how Deming viewed the appearing form of management:

> *Most people imagine the present style of management has always existed, and is a fixture. Actually, it is a modern invention - a prison created by the way in which people interact. This interaction afflicts all aspects of our lives-government, industry, education, healthcare. We have grown up in a climate of competition between people, teams, departments, divisions, students, schools and universities. We have been taught by economists that competition will solve our problems. Actually, competition, we see now, is destructive. It would be better if everybody would work together as a system, with the aim for*

everybody to win. What we need is cooperation and transformation to a new style of management. (Deming, 1993, p. xi)

Table 1: Deming's 14 Points for Management (Deming, 1983, pp. 23-24)

Deming's 14 Points	**Description**
1. Constancy of Purpose	Create constancy of purpose toward improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs.
2. Adopt the New Philosophy	We are in a new economic age. Western management must awaken to the challenge, must learn their responsibilities, and take on leadership for change.
3. Cease Dependence on Mass Inspection	Cease dependence on inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place.
4. End the Practice of Awarding Business on the Basis of Price Tag	Instead, minimize total cost. Move toward a single supplier for any one item, on a long-term relationship of loyalty and trust.
5. Improve the System Constantly and Forever	Improve constantly and forever the system of production and service, to improve quality and productivity, and thus constantly decrease costs.
6. Institute Training	Management needs training to learn about the company, all the way from incoming material to customer. A central problem is need for appreciation of variation.
7. Institute Leadership	The aim of supervision should be to help people and machines and gadgets to do a better job. Supervision of management is in need of overhaul, as well as supervision of production workers.

8. Drive Out Fear	Drive out fear, so that everyone may work effectively for the company. No one can put in his best performance unless he feels secure.
9. Break Down Barriers between Departments	People in research, design, sales, and production must work as a team, to foresee problems of production and in use that may be encountered with the product or service.
10. Eliminate Slogans and Exhortations	Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the work force.
11. Eliminate Numerical Quotas and Management by Objectives (MBO)	The responsibility of supervisors must be changed from sheer numbers to quality, and the job of management is to replace work standards (quotas) by knowledgeable and intelligent leadership. Internal goals set in the management of a company without method, are a burlesque.
13. Encourage Education and Self-Improvement	What an organization needs is not just good people; it needs people that are improving with education.
14. Take Action to Accomplish the Transformation	Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job.

Deming referred to the new style of management as a System of Profound Knowledge (SoPK). This theory of management contains four components (Deming, 1993, p. 96):

(1) appreciation for a system (systems theory);
(2) knowledge about variation (statistical theory);
(3) theory of knowledge (epistemology); and
(4) psychology (theory of human behavior).

To a certain degree, SoPK was a repackaging of Deming's 14 points, but presenting his philosophy as a cohesive system drawing from four fields of widely-known theory made it easier for most management professionals to understand and apply.

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Moen and Norman (2016) note that SoPK is as relevant today as it was 50 years ago. Table 2 describes the basic ideas behind the four components.

Table 2: Deming's System of Profound Knowledge (Deming, 1993, p. 96)
Comparing Agile and Deming's Philosophy

Deming's System of Profound Knowledge	Description
Appreciation for a System	It is important to optimize the *entire* system (a set of activities and processes that work together for the long-term benefit to all stakeholders), not separate components of the system. Optimization of all components separately, rarely leads to optimal system performance. Requires knowledge of Systems Theory.
Knowledge about Variation	It is important to understand the variation in a process including the difference between common-cause and special-cause variation. Proper data analysis is required to understand root causes of observed failures and successes. Requires knowledge of Statistics.
Theory of Knowledge	It is important to understand that knowledge comes from theory and no number of examples or observations establishes a theory. However, a single observed contradiction to a theory necessitates modification or abandonment of that theory. Requires knowledge of Epistemology.
Psychology	It is important to understand people and the interactions between people and circumstances, managers and employees, employees and customers. Managers need to learn how to intrinsically motivate their team.

Rigby, Sutherland and Takeuchi (2017) suggest that agile methodologies can be traced back to the work of Walter Shewhart and his mentee, W. Edwards Deming. The Agile Manifesto does not clearly define QMS requirements but there is an implied support of QMS values regarding providing only what the customer needs at the right time. Although the academic literature is mostly silent on the influence the Deming Philosophy has on current Agile practice, several books and numerous blogs on Agile do speak directly to Deming's work. Kulak (2011) and Hunter (2012) both hypothesize that while many Agile practitioners are unfamiliar with

Deming, a lot of their work manifests his philosophy. Smith & Sidky (2009, p. 244) posit that ceasing dependence on mass inspection to ensure quality echoes Agile thinking and note that "Building quality into the product sounds clichéd and has been overused by many marketing departments. But in an Agile environment, the concept is real and tangible." Furthermore, "Deming focused on eliminating unsatisfactory results before they reached the customer. In Agile parlance, every object must pass its unit, functional, and system test" (Goodpasture, 2015, p. 71). Bloggers have also noted alignment between Agile and Deming principles, including "cease dependence on mass inspection," "drive out fear" and "remove barriers that rob people of pride of workmanship" (Anderson, 2008; Yousuf, 2009).

Drawing upon the literature, and our own knowledge of Deming's framework and Agile, we carefully consider each of Deming's 14 Points and its relationship to the Agile Way of Working. Table 3 illustrates this comparison. There is considerable alignment between the two philosophies, particularly with respect to "constancy of purpose," "cease dependence on mass inspection," and "drive out fear." Principles that Agile does not specifically address include "end the practice of awarding business on the basis of price tag," "institute leadership," "eliminate slogans and exhortations," "eliminate numerical quotas and management by objectives," and "encourage education and self-improvement." Agile does not necessarily contradict these points as much as its principles do not specifically focus on them. For the other six Deming points, we have observed that Deming and the Agile mindset are in alignment although Agile is usually aimed at the departmental or project level rather than the enterprise-wide level. In summary, we believe that Deming would embrace the Agile Way of Working but Deming takes a more holistic and leadership-based approach than Agile.

Table 3: Mapping Deming's 14 Points for Management to Agile

Deming's 14 Points	**Mapping to the Agile Way of Working**
1. Constancy of Purpose	The Agile Manifesto provides constancy of purpose, but not at an enterprise-wise level seen in Deming's philosophy. What is lacking is a clear statement on the aim of the system (i.e., organization) and how the Agile Way of Working can support the aim.

2. Adopt the New Philosophy	Although the Agile Way of Working embraces change, often only a sub-system of the overall organization is attempting Agile methods. In many cases a traditional, Western management style of silos and command and control oversees the departments doing Agile work which can lead to sub-optimization of the system (i.e., organization). The narrow focus of Agile teams relying on technical expertise runs counter to the enterprise-wise view of the Deming philosophy.
3. Cease Dependence on Mass Inspection	Agile's practice of short iterations, with test-driven development with frequent customer feedback reduces the need for mass final inspection.
4. End the Practice of Awarding Business on the Basis of Price Tag	The Agile Way of Working is virtually silent on an organization's relationships with suppliers. This silence is understandable since Agile principles did not develop in a manufacturing environment where the quality of incoming raw materials, parts, and components often dictate the quality of the final product.
5. Improve the System Constantly and Forever	Agile's use of practices such retrospectives, short iterations, and daily standups combined with an Agile mindset of "inspect and adapt" helps to drive continuous improvement of the product development cycle. What is lacking is enterprise-wise practices to constantly improve the system (i.e., organization). Many of Agile's practices could be used in upstream processes such as annual planning, strategy development/deployment, client engagement and project governance. Hoshin Kanri (also called Policy Deployment) can be viewed as an Agile process but with much longer time cycles than daily standups or the typical iteration cycle time.
6. Institute Training	The Agile practice of pair programming is a type of on-the-job training. Deming believed, however, that training needed to go beyond training for the daily tasks and everyone needed to be trained in quality improvement methodologies. Albeit many Agile companies train their employees on Agile practices and mindsets, the depth and breadth of training Deming encouraged throughout the

	entire organization is not common in companies claiming to be Agile.
7. Institute Leadership	Agile practice focuses more on self-directed teams and is mainly silent on developing organization leaders who can learn how to manage the interdependencies of the system and not just the dependencies.
8. Drive Out Fear	Agile does not directly address this point but adherence to two of the statements in the Agile Manifesto declaring "Individuals and interactions over processes and tools" and "Responding to change over following a plan" should help mitigate fear. Moreover, the Agile practice of daily standups should allow problems to quickly come to the surface and resolutions sought before festering for long periods of time. Agile's use of empirical methods to build experience to enable better prediction or estimation contributes greatly to the reduction of fear and aids in confronting management methods based on anecdotal information.
9. Break Down Barriers between Departments	The Agile Way of Working stresses collaboration, however, Agile teams are often comprised within single departments and do not span the entire system (i.e., organization). Agile methods attempt to bring in customer and operations perspectives to the team, but there is not a systems-wide view.
10. Eliminate Slogans and Exhortations	Agile is mostly silent but there is often a team culture that develops in Agile teams where they create slogans based upon their experiences. These slogans tend to bond the team, but can then potentially devolve the department or organization into tribalism.
11. Eliminate Numerical Quotas and Management by Objectives (MBO)	Agile is mostly silent, perhaps even contradictory since time-boxing iterations and focus on quickly getting a minimal viable product to market could be considered MBOs and place completion over quality. Some managers view Agile as the key to increase project completion rates, but undervalue the needs of the entire organization when prioritizing the projects to complete. Agile practices have no method to determine if the right projects for

	organizational success, or perhaps even survival, are being completed.
12. Remove Barriers that Rob People of Pride of Workmanship	Agile practices of retrospectives, show-and-tells, and short iterations allow workers to display their work frequently and gather praise and constructive criticism. Deming's focus on the abolishment of individual merit ratings, however, is still prevalent in most Agile environments.
13. Encourage Education and Self-Improvement	Agile is mostly silent but many Agile practitioners seek additional Agile training via numerous credentialing paths.
14. Take Action to Accomplish the Transformation	The Agile Manifesto implies, at least indirectly, that all people need to get to work to accomplish the aim. However, as noted several times above, the lack of Agile practices and mindset applied to the entire system (i.e., organization) can result in Agile teams being constrained by a traditionally managed organization where the focus is not on continual improvement of the entire system. In its current form, Agile is mostly blockaded in the IT department. Some organizations have even separated Agile teams from the traditional IT department.

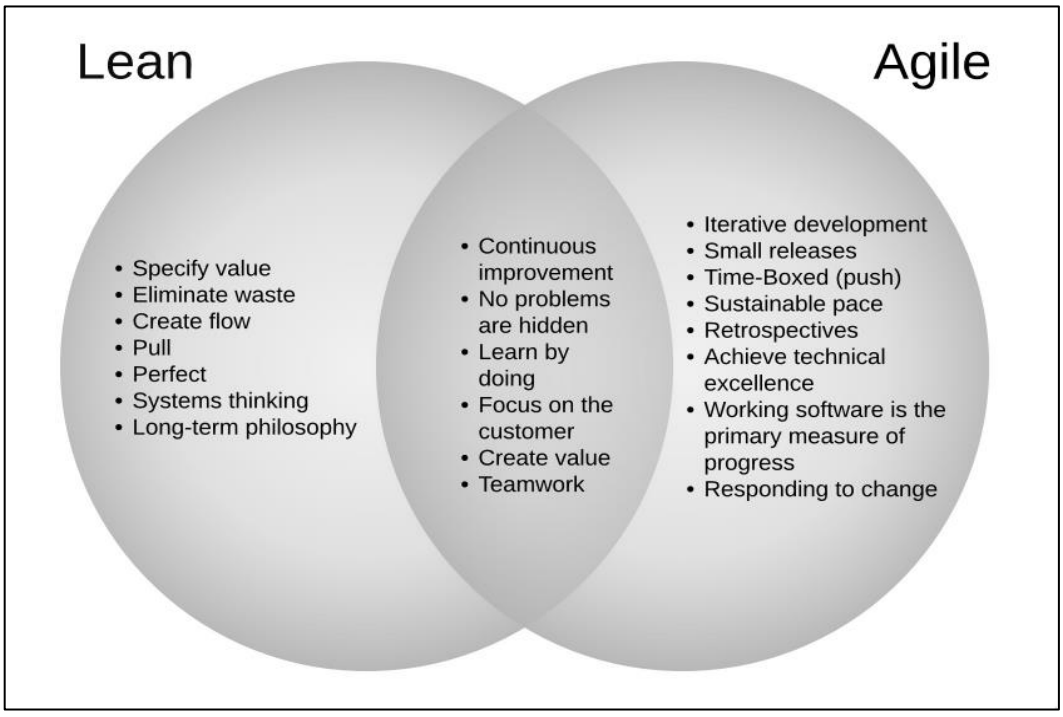
Comparing Agile and Lean

Before the software developers met at Snowbird, Utah, in 2001, Womack *et al.* (1990) and Liker (2004) analyzed the Toyota Production System and applied the term "Lean" to industrial processes looking to remove waste and generate value for a customer. Deming's early work with Toyota and others in Japan is evident in both the Toyota Production System and the early applications of Lean manufacturing.

In Figure 2 we see that Lean and Agile share many of the same basic ideas and characteristics. Both seek to remove waste from a process that is (supposedly) generating value for a customer. Pillai *et al.* (2012) describe Lean as an Agile methodology for change management. One contrast is Lean's "pull" requirement against the time-boxed iterations of Agile's inherently "push" system. Secondly,

the systems orientation of Lean (including emphasis on process flow and long-term thinking) is not clearly apparent in Agile. A similar analysis also concluded

Figure 2: Lean and Agile



that while Lean and Agile have much in common, their principles are not directly aligned (Chan, 2013). Chan also suggested the need for Agile to adopt a Lean mindset focused on optimizing the entire value stream rather than separate technologies and referred readers to a Lean Enterprise Institute article that included the following quote:

> *"… lean thinking changes the focus of management from optimizing separate technologies, assets, and vertical departments to optimizing the flow of products and services through entire value streams that flow horizontally across technologies, assets, and departments to customers." Lean Enterprise Institute (2013)*

Another contrast between Lean and Agile that we have observed is that some software developers believe Lean is all about process, thus stifling innovation. Developers often view their work as more creative rather than process

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driven; while Agile can be potentially seen as a creative ally, Lean is often viewed as a lumbering process that impedes innovation or is associated with manufacturing and thus has no relevance to software or technology (Anderson, 2012). The next section proposes that these differences can be mitigated with a systems view recognizing that innovation requires both a creative process and adaptation to the long-term philosophy of creating value for the customer.

AGILE'S ROLE IN QMS

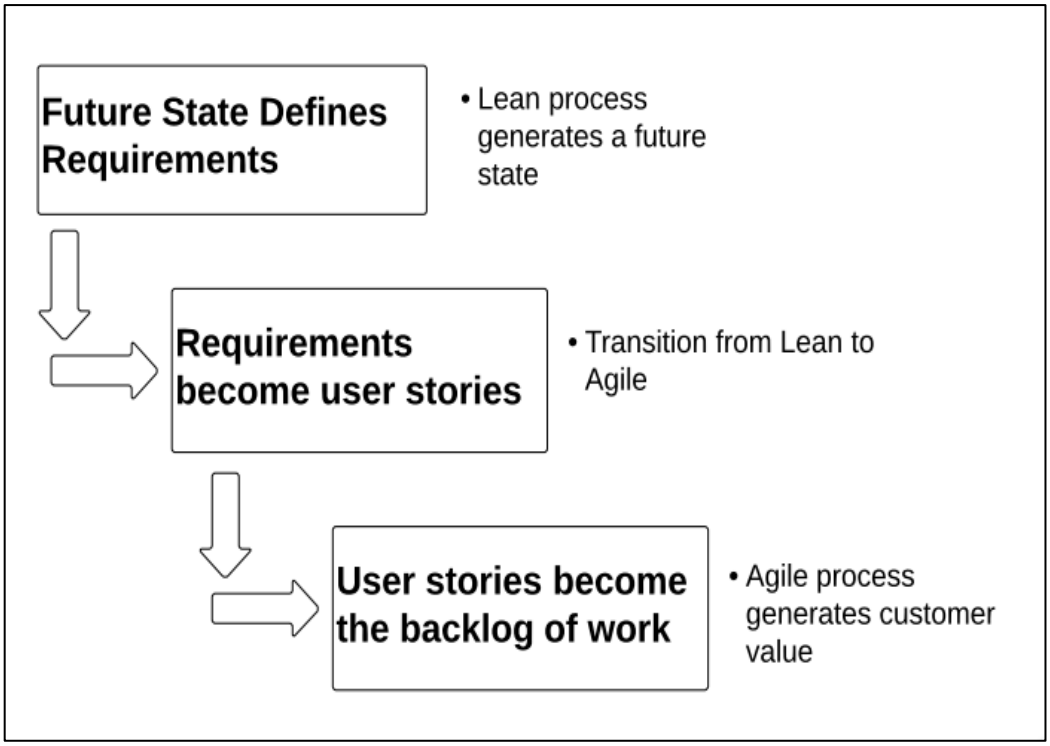
We contend that while Deming's philosophy reflects some of Agile's principles, Agile should not be considered a stand-alone QMS. Deming was a strong advocate of a systems view, which Agile does not emphasize. In this section, we present a strategy of incorporating a system perspective into the Agile Way of Working by using the Lean method to generate basic project requirements and then taking an Agile approach to process design and improvement. Second, we propose a more holistic view by looking at the framework provided by SoPK in comparison to Lean, Six Sigma and Agile.

Combining Lean and Agile

Shalloway *et al.* (2010) and Shalloway (2016) suggest using Leanban, an approach based on Lean thinking that incorporates several Agile practices such as Kanban, Scrum, and eXtreme Programming. Further, there is the perception that if a project group (software developers, product designers, etc.) is using an Agile method, it doesn't really need well-defined requirements that support the entire organization and the project group can just start building something they think will please the customer based upon the narrow perspectives of the team members. Yet without clear initial requirements, the output will often be unsatisfactory and not contribute to the whole of the organization (Hoffmann, 2015; Johnstone, 2015).

The model in Figure 3 (proposed by Miller, 2014a, 2014b) illustrates how Lean and Agile can work together. First, a Lean method such as value stream mapping can identify and appraise the current state, and once the current condition is understood, a future state is developed. The future state defines the requirements needed for the project. Second, the requirements are written in the form of user stories (an Agile tool used to capture a need from an end-user/customer perspective). The user story should describe the type of end-user/customer and what they want and why. Third, the user story cards can be placed on a Kanban board to represent the backlog of work needed to complete the project.

Figure 3: How Lean and Agile Work Together (Miller 2014a, 2014b)



Improvement efforts that focus only on the use of tools, often fail. Approaching improvement efforts from a systems perspective can significantly raise the possibility of success. The model in Figure 4 illustrates a system's view of a service operation, from design to the customer. IT frameworks such as IT Service Management (ITSM) and Enterprise Architecture have emerged in recent decades in parallel to advancements in QM. These frameworks are all attempts to abstract the complexity of technology to provide meaning to multiple stakeholders which then allows QM tools to be applied. The model illustrates the various components of the system and the intricate interdependence among those elements. Optimization of the system requires an aim, communication, collaboration, and a contingency approach regarding what QM or IT frameworks to rely upon.

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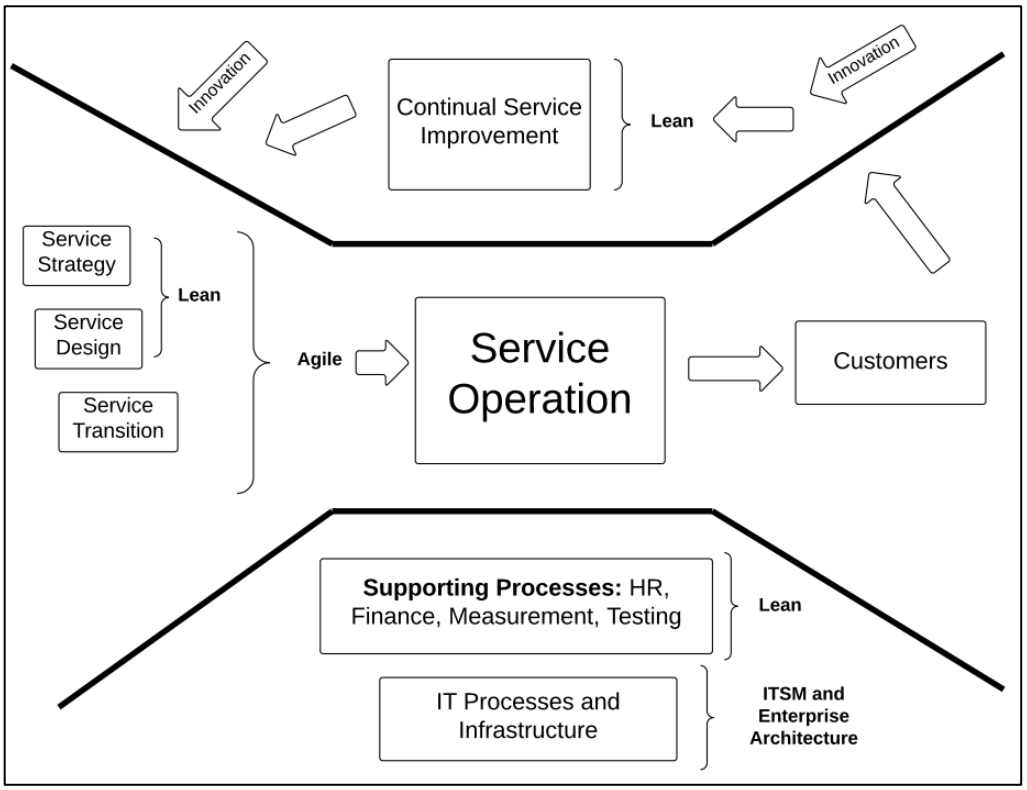
Figure 4: A Systems View Incorporating Lean and Agile



A Contingency Approach to QMS using Deming's SoPK Framework

As noted above, we believe that Deming's work is consistent with an Agile mindset, however Deming's SoPK requires more than just an Agile Way of Working. The implications of this analysis are perhaps best articulated through the four components of SoPK. Table 4 reflects our conclusion that Agile is strong with respect to "psychology" and "theory of knowledge," but weak regarding "knowledge about variation" and "appreciation for a system." As discussed above, Lean thinking could be used to overcome the Agile framework's shortage of a system's view. Table 4 also pinpoints the relationship of the four components of SoPK to Lean and Six Sigma. Lean is particularly strong with respect to "appreciation for a system" and Six Sigma's often-stated focus on identifying and reducing variability results strongly aligns with "knowledge about variation."

Table 4; System of Profound Knowledge (SoPK) and Strength of Relationship with Agile, Lean and Six Sigma

The Four Components of Deming's System of Profound Knowledge	Relationship to Agile	Relationship to Lean	Relationship to Six Sigma
Appreciation for a System	Weak	Strong	Moderate
Knowledge about Variation	Weak	Moderate	Strong
Theory of Knowledge	Strong	Weak	Moderate
Psychology	Strong	Moderate	Weak

As mentioned in the introduction, the contingency approach to QM recognizes that an organization's QMS depends on many factors including project-specific contingencies. For example, suppose Project A requires reducing variation and Project B necessitates a motivated workforce. Thus, Project A should benefit most from Six Sigma thinking and tools, and Agile would complement Project B. More importantly, complex problems generate complex projects. Having the ability to think holistically and draw from all four components in the SoPK should provide organizations the highest probability of successfully meeting these challenges.

DISCUSSION

It's The System and Change is Hard

Humans progressed into the agrarian era by developing silos to store agricultural surpluses that are not supposed to mix; we have continued the practice through the industrial and modern technology ages by creating expertise silos where skills, worldviews, knowledge, and wisdom don't mix due to the rigid nature of

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organization charts and company culture. The hierarchical nature of organizations attempts to associate expertise with those in power, but increasing complexity often prevents a higher ranking professional from spanning multiple areas of expertise. Thus exist groups of people who view themselves as experts in their areas, but ultimately the entire organization does not share a common aim. Managing a complex organization without a systems view regarding strategic planning, process, people and technology will weaken an organization. Forward-looking leadership focuses on creating and managing a system that has an aim, provides value to customers and allows employees to succeed and have pride in their work.

Methods of improvement or QM tools often get attached to the various islands of experts. For example, there is the perception that Agile is only good for software developers and that Lean is best for cutting costs and removing waste in a manufacturing setting or physical service areas. Service organization employees believe that using Six Sigma or statistical process control is only relevant to a manufacturing company. Often an improvement effort is started in one silo of a company and resisted or feared elsewhere. Thus, the whole organization suffers due to the sub-optimization of the system; employees are frustrated and customers receive products of lower quality and higher price. The Not-Invented-Here (NIH) phenomenon often starts when false pride drives one part of an enterprise to use a less-than-perfect tool or method in order to save face by ignoring, boycotting or otherwise refusing to use potentially superior approaches being championed by others.

Agile has been adopted by organizations to build usable software. Lean and Six Sigma are often still perceived as tools to improve IT-oriented business processes but not IT organizations. These tools and methods are often used by both product and service organizations in small, sporadic attempts, usually with much implementation confusion as leadership typically struggles to provide a unified view of the change effort. Workers in organizations aiming to improve often view the methods of Lean, Six Sigma and Agile as separate, transient, non-aligned or even contradictory methods. This view potentially limits a systems perspective, misunderstands Lean or perceives Lean is only for manufacturing and Agile is only for software and the two cannot complement each other.

In the siloed, fear-generating, hierarchical, expert-based, technological worldview, the systems thinkers have often found themselves in positions of what Backaitis (2013) calls "courageous despair." They see the larger picture and keep trying to change things, often at risk, but are always working against the prevalent, competitive, command and control management systems. To prosper in the future, we believe that organizations need leadership that embraces the systems thinking

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of those with courageous despair and recognizes the advantages of a contingency approach to QM that uses the proper tool in the right time at the right place.

The Path Forward: An Outside Systems View

Individuals acquire a succession of empirically-derived worldviews through the potentially narrow experiences of their lifetimes. Deming called for both horizontal development that contributes to the expert view and vertical development that contributes to the outside view that allows one to help the system understand itself by helping those in the system see the larger systems view. He believed horizontal development is delivered primarily by our current educational system, and vertical development is delivered by experience outside our current educational system. By having more vertical development and a better understanding of the system, people can operate in a manner that not only makes themselves or their department look good, but creates products and services that have value for customers and that benefits everyone (management, workers, customers, and suppliers).

With an increasing world of volatility, uncertainty, complexity, ambiguity and the pervasiveness of connective technologies, an outside systems view is essential. However, the current cultural personality ideal favors the technology titan, the achiever and the expert, and generally resists the outside view. Perhaps this reductionist view of what is "the best" is a response to increasing complexity? Understanding the system requires more effort where people rise above their individual points of view to understand the system in the context of its overall goal, understand what the organization does to achieve this goal, understand its boundaries and constraints, and sharing the sensing and feedback mechanisms with the entire organization. While Agile can play a significant role in a modern QMS, a deeper understanding of the system requires knowledge drawn from and synthesized among multiple approaches towards quality and productivity improvement.

CONCLUSION

We suggest that a contingency approach to QM requires organizations to understand the many variables that affect an organization's creation and use of a QMS with its collection of tools. By presuming that Deming's SoPK is the most holistic proven approach to improving quality, organizations can infer when and where to focus on systems thinking, statistics, epistemology and psychology. Since Lean, Six Sigma, Agile and other new and emerging approaches do not rate evenly across these four components, an umbrella approach to building a QMS appears to

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be optimal. Our paper suggests that an effective QMS can benefit from the inclusion of Agile. Perhaps most importantly, the best approach, methods and tools to use can be contingent on the specific project an organization is undertaking and can differ from project to project.

We believe Deming's philosophy included elements of Agile, but using Agile does not mean an individual or organization fully embodies the Deming philosophy. In our opinion, the Agile movement and current Agile practices have not fully embraced systems theory. While Agile has its role in QM, it is not a stand-alone QMS.

Implications for Organizations

Organizations need to recognize the growing use of Agile, both in IT departments and as an innovation tool to develop new products and services. Second, in today's high-tech environment many, or perhaps most, quality improvement projects involve the direct input or support from IT, and it is important to recognize that that involvement will increasingly be coming from an Agile mindset. Better outcomes are therefore dependent on increased Agile training to all areas of an organization.

The most effective QMS will contain multiple tools and mindsets and fitting the right projects with the right tools and mindsets is critical. Going Agile is not enough. Organizations need to evolve their QMS, incorporating Agile now if they haven't already done so, and including new and emerging approaches as they prove themselves effective.

Limitations

Our work is a synthesis of decades of IT and quality improvement experiences, existing literature, teaching, industrial consulting, and critical observation and reflection. The views in this position paper are limited by a lack of empirical data, and any personal bias resulting from our own experiences.

This paper relies heavily on the work of Dr. W. Edwards Deming and his System of Profound Knowledge which was introduced in 1993. Although some critics dismiss Deming's ideas as simply outdated, it can also be argued that Deming's management theory has not been thoroughly tried and tested. Furthermore, some quality experts have noted its continued importance in contemporary business practice (Conklin, 2014; Moen and Norman, 2016) and that modern QMS include the tools and theories promoted by Deming (Antony *et al.*, 2017; Rigby *et al.*, 2016).

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Suggestions for Further Research

Different methodologies have their own cultures and language. QM literature is mostly silent concerning the language of QMS and the damaging affects of jargon. Six Sigma and Lean emerged from the manufacturing sector and the corresponding language and terms associated with it make it easy for potential adoptees in the service sector to dismiss the methodologies. Similarly, Agile is deeply rooted in IT and the terminology can hinder non-IT applications. Moreover, our increasingly technology-based world has generated multiple levels of language, context and meaning and multiple groups have difficulty coming up with the same meaning over a single word. For example, the word "service" is one of the more maligned words of our current era. Trying to come up with an agreement about the meaning of "service" in a modern organization is difficult. We recommend that researchers develop a common language free from sector-specific jargon that is acceptable and easily understood by all.

Based mostly upon observation and experience, this paper proposed the inclusion of Agile to increase the effectiveness of quality and productivity improvement initiatives. The next step is to quantify the advantages and roadblocks of incorporating Agile in existing QMS. Of particular importance is the convergence of an Agile mindset with the mindsets of Lean, Six Sigma, etc. Empirical studies are also needed to better understand how leadership can support, train, and reward system thinkers. Does your organization motivate individuals to optimize the overall effectiveness and efficiency of the organization, or is everyone working as hard as they can to optimize their own personal outcomes without consideration of how it affects other individuals and departments, the customer, and the bottom line?

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