AC 2012-4876: ORGANIZATIONAL CULTURE IN SUPPORT OF SIX SIGMA AND INNOVATION: CAN IT CO-EXIST?

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Innovation, Creativity and Six Sigma in Business Performance

Sai Chennupati, Chad Laux, Kathryne Newton and Kelly McFall

Introduction

This paper examines the use of Six Sigma as a source for creativity and innovation. Innovation and creativity goes hand-in-hand; creativity brings about innovation. Six Sigma is known to be an efficient quality methodology that may also result in innovation[1]. Six Sigma is not just about doing things better; it is a way of doing better things[2]. In this paper, the various types of innovation and creativity are described. The two concepts are intimately related and it is important to appreciate Six Sigma's role in innovation[3]. In subsequent sections, we discuss how Six Sigma (SS) may initiate and influence creativity and innovation. This paper describes innovation and the different types of innovation. The SS methodology is described as a point of origin that results in innovative benefits through a SS approach. The paper finally concentrates on the barriers to creativity and innovation in SS project.

Impact and definitions of innovation and creativity

Innovation is an important topic due to the impact of novelty in the global economy. The impact of innovation on global economy is directly proportional. According to Figueroa and Conceicao[4] innovation is accepted when it has acquired economic relevance. Specific to the United States, innovation is important to state and regional economies. Within a nation state, for example, the Idaho's Department of Commerce, companies that innovate contributed 18.4 percent to the state's economy, or $8.4 billion of a total $45 billion Gross Domestic Product (GDP). The contribution by innovation to industry was higher than the combined GDP of traditional industries of the state. Schumpeter[5] explains that technology innovations lead to economic development. Schumpeter[5] further states that the innovation process is linear; beginning with inventions and ending with innovation. The larger the scale of innovation, the greater a company's chance to sustain competition and lead the

competitive field in the general economy. A more traditional definition of innovation relies upon description through product performance, product system and service innovation. An economic discussion of innovation is confined to a narrower definition of innovation.

There is no single, specific definition for innovation and definitions are dynamic. Experts define innovation through a variety of perspectives. One perspective about innovation is that it brings about meaningful economic, environmental and social changes to existing or new processes and/or products. Innovation experts define innovation in many ways. Thomson[6] defines innovation as the generation, acceptance, and implementation of new ideas, processes, products and services. Damanpour[7] defines innovation as the capacity to introduce new processes, products, or ideas within an organization. Hurley, Hult, and Tomas[8], relate innovation to a firm's capacity to engage in innovation; that is, the introduction of new process, products, or ideas in the organization. Innovation can be applied to any existing process, product or a service. The Stanford Center for Professional Development categorized innovation as shown in Figure 1 below[9].

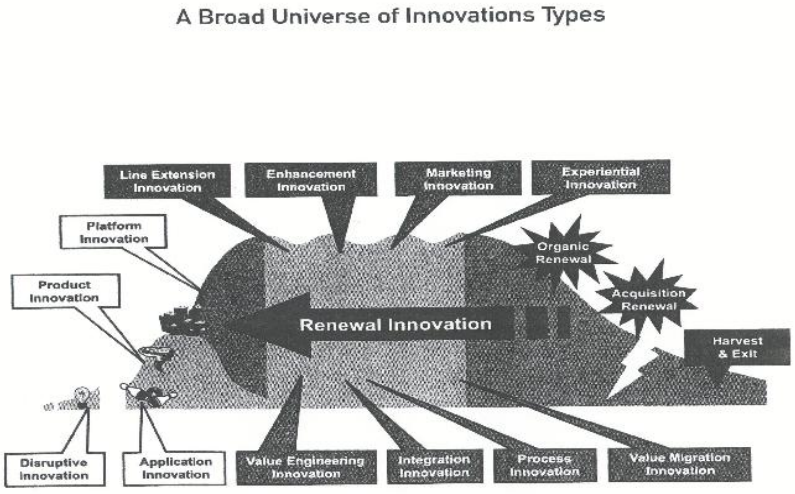

Figure1: Types of Innovation

Doblin (www.doblin.com), classifies innovation into ten types and under four categories: finance, process, offering and delivery. Business model and networking

innovation comes under financial innovation. The business process management (BPM) strategy of process innovation is expressed in a recognition, development, and standardization through enabling process and core processes[10]. Finally, the marketing concepts of market channels, branding, and customer experience comes under delivery innovation and relates to marketing functions[10]. Organizations increasingly rely upon creativity to boost innovation.

Creativity impacts the innovative process. Innovation and creativity are synonymous in many definitions and may rely on similar cognitive activities. According to Unsworth[11], creativity is based on a novel and useful idea. Creativity operates efficiently when it does not concern the following three factors: regardless of the idea, reasons behind its production or the starting point of the process[11]. In a system dealing with process and product, creativity and innovation go hand-in-hand. Creativity, like innovation, is not confined to few particular types. The different types of creativity on the other hand are described by Unsworth[11], as shown in the below Figure 2.

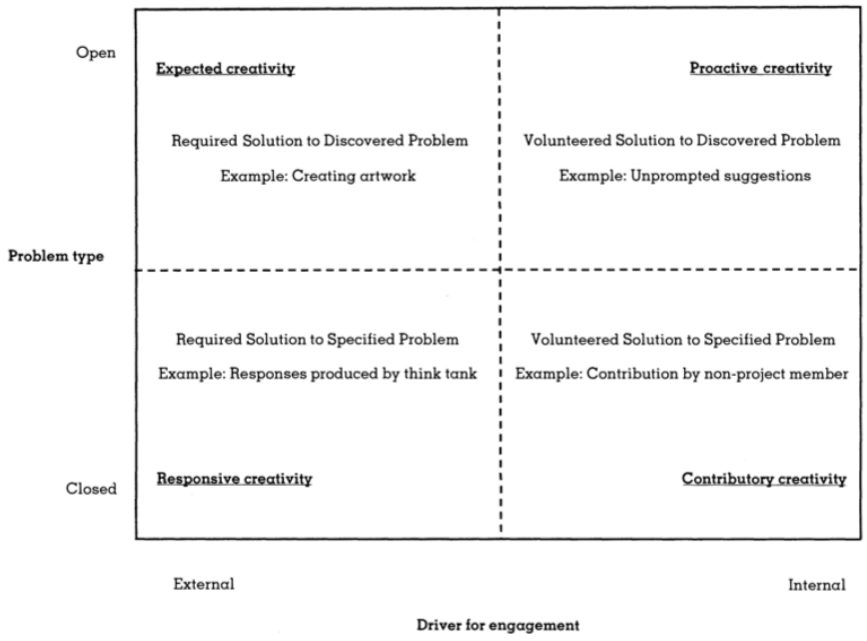

Figure 2: Matrix of Creativity Types

Unsworth[11] identifies four types of creativity based on problem type and drivers for engagement: responsive creativity, contributory creativity, proactive creativity and expected creativity. Responsive creativity is an externally driven, closed-problem type where the participant having the least control of the situation only responds to the requirements of the situation and to the problem presented[11]. Expected creativity can be closely associated with the type of outcomes that needs to be achieved in through effectiveness and efficiency design goals. Expected creativity exists in a situation where the organization knows the solution to the required problem. Contributory creativity occurs when the participants engage in the problem indirectly for example, through volunteerism. An example would be the creativity of the responses to a survey given by participating volunteers. Finally, proactive creativity exists when the problem type is open-ended and has an internal driver for engagement. Creativity as a process exists as well. Unsworth[11], described the relationship through two questions that underlie engagement in the creative process. First, why do people engage in creative activity? Second, what is the initial stage of the trigger? As demonstrated above, this ambiguity is typically interpreted according to organizational and individual perspectives. The definitions of innovation, creativity and quality share ambiguity of perspective and enacting positive change through adoption of innovative methodologies, utilizing an organization's internal resources and capabilities, could drive a firm's business performance though variation in creativity, innovation, and quality.

The characteristic of quality has been utilized as a strategic advantage for over 100 years and has been expressed through statistical quality control, quality prevention and assurance, total quality management, and lately, Six Sigma (SS). Six Sigma is a formal and disciplined methodology for defining, measuring, analyzing, improving, and controlling a process[12]. Six Sigma may also be defined as the philosophy of statistical changes attacking variations continuously in a process/product focusing on the dedication of improvement. Six

Sigma is a statistical and philosophical approach to achieve/improve the quality specifications for a process/product in an organization. As the definition and the inherent objective indicates, achieving 3.4 defects per million, requires creativity and innovation in a large scale. Organizations use two project methodologies to reduce variations, including a methodology based upon improving existing products and/or processes (Define, Measure, Analyze, Improve, Control, or DMAIC), a methodology largely based upon devising new products/processes (Define, Measure, Analyze, Design, Verify, or DMADV), or an earlier variation of DMADV (Design for Six Sigma or DFSS). Another principle of Six Sigma, beyond integration of varying previously devised quality tools is a characteristic of objectivity. Six Sigma derives from quality management a data-driven approach for the methodology. Identification and description of variation by practitioners is oriented toward statistical and subsequent practical solutions. An important challenge for managing Six Sigma is the difficulty in creating quantitative value from a mixture of tangible assets, such as those described above, and intangible assets such as organizational learning, shared vision, commitment to learning, open-mindedness and intra-organizational learning.

Creativity, Innovation and Six Sigma

Six Sigma is a methodology that blends quantitative characteristics and qualitative assets to create a better value proposition for organizations implementing the Six Sigma methodology. An organization may typically pursue Six Sigma to improve operations across the value chain. Improvement may be characterized as better resource management delineated in terms of efficiency and effectiveness. Regardless of the perspective or practitioners, the results from 'problem solving' are enhanced by creativity and innovation. Because the majority of innovation identified and described by organizations is from business operations, Six Sigma practitioners should have creativity and innovation as a basis, along with quantitative ideas. Let's look at creativity and innovation through the DMAIC approach.

Because DMAIC is the primary methodology for utilizing Six Sigma, DMAIC is the lens through which Six Sigma, creativity, and innovation will be viewed. DMAIC is primarily associated with process improvement. The Define phase explains a body of work through a collaborative project determined by identifying critical customer requirements as project goals. Project goals may be objective but are typically linked to a business's primary assets, named critical success factors. This exercise requires strategic thinking to be done correctly. The measure phase quantifies project goals through establishing baseline performances of identified metrics. Often, improving variation and centrality of project metrics are done by collecting relevant data, understanding measured results and interpretation through various statistical tools. In the analyze phase, study of the relevant data is done to determine cause and effect relationships among business inputs and outputs. The improve phase is done to optimize current process performance utilizing original team ideas. Finally, the control phase is done to secure process improvements and sustainability of project goals. Six Sigma may stimulate creativity/innovation through DMAIC but it is not the primary method to influence an organization to innovate[13]. Opposing the statement just made, this paper proposes a model for explaining how creativity and innovation are triggered in a Six Sigma process.

From the perspective of the organization implementing Six Sigma, project participants are subjected to expected and proactive types of creativity. A Six Sigma project is an open exercise without predetermined solutions identified. Notably, a primary decision point for not undertaking a Six Sigma project is to validate identified solutions predetermined to the engagement of a DMAIC project team. In addition, a Six Sigma process is meant to be proactive by causing events for improvement rather than react to the environment. As mentioned previously, the characteristics of openness and proactivity are also hallmarks of creativity. Successful Six Sigma projects share the same characteristics. Organizationally,

strategic Six Sigma should engage in problem types that are open to the organization, including an orientation toward novelty for solving to reach project goals in an effort to achieve total quality. There are constraints. To apply creativity in solution generation may require an external resource but the drivers for the organization are internal involving improved business performance.

An organization in the initial stages of Six Sigma adoption under the constraint of improving business processes typically starts from problem identification. Projects are chartered and teams oriented toward solving problems between the expected and actual business performance. This transition is a typical approach. Let us assume that the ultimate goal for a Six Sigma project is to achieve a Six Sigma level process capability (C_p>1.33). This may be the point of origin for a project team. Project definition is limited at this point but expands as a project team moves beyond the initial, define phase. While the purpose during 'measure' is to create a baseline of performance, a project team starts to expand initial horizons beyond the constraints of the initial case. A project team will start to expand their perspective due to the characteristic of openness: the solutions are unknown at this point. As the group reaches analyze, expansion of perspective has reached a point where the group engages in proactivity: creating a situation for future improvement rather than react through the activity of define and measure. Analyze may be distinct as an apex in the use of quantitative tools. Viewed through the lens of quality assurance, team activity may be marked by an increased elimination of potential causes toward a vital few 'root' causes but validation, experimentation, and designing new systems to improve business performance will be expanded by group creativity toward innovative solutions. This expansion may be marked by brainstorming or other similar activities but the goal is for a group to move beyond to typical work and create original effort through experimenting, characteristics closer to innovation than quality control and assurance. The perspective of potential project

resolution is widest at the improve stage and narrows again as a group makes decisions by eliminating alternatives. As the team starts implementing the ideas necessary for project resolution, the group narrows down all potential approaches until by the Control phase, specificity is reached to focus on sustaining teamwork. As an abstraction, Figure 3 illustrates the interaction of Six Sigma, creativity and innovation.

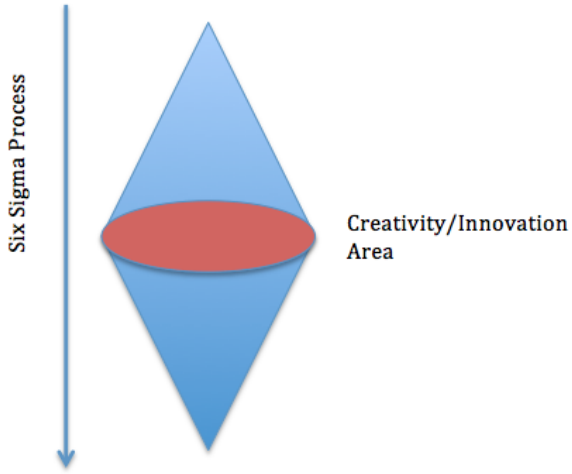

Figure 3: Point Approach of a Six Sigma Project

Figure 3 gives an illustration of the point approach of the Six Sigma project discussed above. The shape indicates the stage where most of the creativity and innovation occur during the course of a Six Sigma project. Creativity exists when an organization engages in categorizing a problem or simply, creativity may be found or exercised in a problem solving situation. Creativity and innovation help a team expand perspectives before designing conclusions. Innovative ideas help a team design the most favorable solutions for project goals.

Barriers to Creativity and Innovation in Six Sigma Projects

Six Sigma has been described primarily through the perspective of process improvement that may be a result of the methodology's origins in quality engineering[14]. Six Sigma is a creative and innovative activity that requires attacking the barriers that Six Sigma organizations encounter before adoption. Yeung[15] divides organizational improvement, like

Six Sigma, into two approaches. The first approach focuses on the tangible assets of organizational improvement, such as cycle time, productivity, and financial gains[15]. A second approach focuses on the intangible assets like organizational learning, knowledge transfer, motivation, employee loyalty and innovativeness[15]. An organization that strives for improvement may tangibly focus on those benefits more easily measured. Due to the challenges of learning how to adopt a new methodology and add a body of knowledge to the workforce, an organization may focus on how well the newly adopted discipline, like Six Sigma, is benefiting the organization. As a matter of principle, Six Sigma endeavors explicitly link project goals and activities to financial measures the organization already possesses[14]. However, an organization must be successful in tackling intangibles as well, such as culture and knowledge management. An organization interested in managing intangibles like knowledge management is attempting to be an organization that is oriented toward learning. A learning organization is focused on sustainability of performance based upon employee growth (Senge, 1990). A learning organization is continuing to develop new knowledge for the organization[16]. For operations management, investing in intangible assets like organizational learning provides an investment with initial, unknown returns on investment. According to Breyfogle[17], Six Sigma projects impact business performance through material savings but justification of intangibles remains challenging. The nature of intangibles presents various barriers to creativity and innovation since the accounting of resources for intangibles requires recognition of activities, rather than tangible assets.

According to Yeung[15], evidence of a learning organization contributes consistently to high performance ratings, high internal efficiency, customer satisfaction and financial performance. However, a focus on intangible returns is coupled with a methodology, like Sigma, that also provides tangible benefits. Problems with introducing intangibles is related to company culture, requiring a top down approach to implementation to ensure

organizational orientation emphasizes comprehensive benefits (Kotter article).

Chakravorty[19], "Where process-improvement projects go wrong" describes some important intangible issues that occur during the course of a Six Sigma project. These issues can also be argued to be the barriers to an innovation process in an organization implementing Six Sigma. The author constructed his paper based on a study conducted on an aerospace company. Chakravorty[19] compares a Six Sigma project to that of a spring's stress-strain curve. A stress-strain curve is characterized by three phases- stretching, yielding, and failing. In the stretching phase, the executives participate in the project involuntarily through contribution creativity. The project was declared a success when the team achieved the goals. In the yielding phase, the process improvement expert and the top management moved their focus to other projects. This is where implementation difficulties started to occur. This is also the phase that may act as a barrier to creativity and innovation. There are various reasons for the difficulties encountered. A few of them to note are: confusion within the organization, one project causing hindrances to other projects, change of focus in objectives and mission and implementation difficulties. The reasons just mentioned are important because creativity and innovation cannot occur in an atmosphere where the team members are involved with dispersed interests. This leads to the final phase, failing. In this phase, the team members with dispersed interests/focuses are unwilling/unmotivated to tackle improvement tasks. This leads to the collapse of a Six Sigma project due to the barriers created that cause hindrances to creativity and innovation.

Summary

The Six Sigma methodology has a comprehensive impact on initiating and influencing creativity and innovation efficiently. The authors' describe Six Sigma methodology suggesting that it not only initiates creativity and innovation, but it is also an

efficient tool for creativity and innovation to take place. Various intangible barriers to creativity and innovation that are difficult to quantify and justify were discussed using case studies from Yeung[15], Hanna[18] and Chakravorty[19]. Chakravorty's unique comparison of a SS project to a stress-strain model was explained.

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