The effect of Six Sigma projects on innovation and firm performance

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Abstract

The paper develops a theoretical base for the effect of Six Sigma projects on innovation and firm performance. It has been proposed that Six Sigma projects enhance technological innovation of the firms; however, they are beneficial for firms in stable environments. Since Six Sigma programs are focused on variance reduction and efficiency, these initiatives are not very effective in dynamic environments, where the rate of technological change is dramatic. With their emphasis on variance-reduction and efficiency Six Sigma programs can be effective in enhancing incremental innovation. In addition, due to the focus of Six Sigma projects on existing customers, they may impede innovation for new customers. Accordingly, implementing Six Sigma projects in fast pace environments with high level of innovation and change may be a challenge, and may not result in the expected outcome. Building upon theories from process management and quality management the paper proposes several propositions to address the effect of Six Sigma projects on innovation and firm performance.

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Keywords: Six Sigma; Project management; Process management; Technological innovation; Exploration; Exploitation

1. Introduction

In the pursuit of higher operational effectiveness and organizational performance, scholars and practitioners are looking for new approaches to improve operational performance, boost profitability, and enhance competitiveness. As a structured methodology emerged from quality management, Six Sigma has attracted academic research in recent years (Raisinghani et al., 2005; Schroeder et al., 2008). It has been identified as a process improvement approach that dramatically improves performance, enhances process capability, and produces bottom line results for organizations (Dasgupta, 2003; Linderman et al., 2003; Pantano et al., 2006). Evans and Lindsay (2003) define Six Sigma as a business process improvement approach that seeks to find and eliminate causes of defects and errors, reduce cycle times and cost of operations, improve productivity, better meet customer expectations, and achieve higher asset utilization and returns. According to Hammer (2002) Six Sigma employs a project-based methodology to solve a specific performance problem recognized by an organization. The focus of Six Sigma is on the customer rather than the product (Douglas and Erwin, 2000).

Although scholars and practitioners cite numerous examples on the positive effect of Six Sigma projects on firm performance (e.g. Hoerl, 1998; Rucker, 2000; Roberts, 2004; Johnson, 2005; Foster, 2007) there are concerns and criticisms about the effectiveness and impact of Six Sigma projects. In the US banking industry, Bank of America and Citigroup were considered as organizations that heavily invested in Six Sigma and benefited from it (Rucker, 2000; Roberts, 2004). Despite the popularity of Six Sigma programs there is little theoretical support on the
effectiveness of Six Sigma projects on organizational performance. Some argue that Six Sigma is simply a repackaging of traditional quality management which is subject to the limitations and criticisms of quality programs (Dahlgard and Dahlgaard-Park, 2006). Accordingly, there is a need to better understand organizational and contextual variables that facilitate or impede effective implementation of Six Sigma projects.

The purpose of this paper is to develop a theoretical framework to determine the effect of Six Sigma programs on innovation and firm performance. To do so, the foundation of Six Sigma and its underlying assumptions will be discussed. In addition, the role of Six Sigma projects in addressing both incremental change (exploitation) and radical change (exploration) will be addressed. Finally, the paper provides insight on the external variables that can influence the effect of Six Sigma programs on firm performance.

2. Quality management and project management

The principles and premises of project management have been evolved over time. Traditionally, project management has been conceived as an organized plan to achieve pre-determined goals within a specified timeline (Laszlo, 1994). In this viewpoint, trade-offs among time, cost, and quality are inevitable (Khang and Myint, 1999). Recent thinking in project management treats projects as sets of practices aiming at providing better quality products and/or services to customers through integration with other organizational practices and effective utilizations of resources (Cicmil, 2000).

Project management principles, guidelines and techniques can contribute to the success of quality-related projects (Somasundaram and Badiru, 1992). This suggests a link between quality management and project management since customer satisfaction is regarded as one of the key principles in quality management (Dean and Bowen, 1994). Antilla (1992) suggests that utilizing the concepts proposed by quality standards and quality systems (e.g., ISO-9000) is significant in establishing the quality of projects. In that regard, research in the relationship between quality management and project management will provide insight on how quality concepts can be effectively utilized in project management.

Research on quality management and project management is surprisingly rare. Cicmil (2000) addresses the lack of research in project quality, and stresses the need to conduct more research to integrate quality concept with project management. It is suggested that a multi-perspective approach to project management will result in better project outcomes (Cicmil and Terziowski, 1999). This view suggests integration and inclusion of multiple, multi-level quality concerns in project management through balancing the expectation of different project stakeholders. Utilizing the project management multiple perspective (PM-MP) framework, Cicmil (2000) identifies three key areas for successful project management: project context, project content and organizational behavior. Project context deals with the organizational context, specific industrial settings, and organizational or business strategies. The primary focus of project content is to make sure project objectives and methods of achieving them have been properly defined in the early project stages (Turner and Cochrane, 1993). The organizational behavior aspect is concerned with designing an effective project structure, dealing primarily with human element of project management (Anderson, 1992). Attention to these characteristics will ensure that a project can achieve its desired objectives and will lead to higher quality projects.

While previous studies have revealed key determinants of project success and sharpened our insight on how to design and plan effective projects, quality and innovation issues in project management have received little attention. Furthermore, the link between organizational processes and project management has been overlooked in previous studies. To fill this gap in the literature, To fill this gap in the literature, this paper focuses on Six Sigma projects. Six Sigma projects are primarily improvement projects trying to enhance improvement in organizational processes and routines thorough focusing on pre-determined and specific goals. This paper is primarily focused on the effect of Six Sigma projects on firm innovation and performance. Since Six Sigma projects are characterized under quality management, the focus on Six Sigma projects can contribute to our understanding of the link between quality, innovation and project management. Therefore, it is believed that looking at Six Sigma projects can enhance our understanding of effective implementation of project management and project outcome.

3. What is special about Six Sigma?

The fundamental difference between Six Sigma and other process improvement programs (such as TQM, Lean, and the Baldrige model) is related to the ability of Six Sigma in providing an organizational context that facilitates problem solving and exploration across the organization. While Six Sigma programs have their roots in the quality movement, they are different from other quality programs (e.g., lean systems or ISO-9000) due to their limited time-frame, measurable and quantifiable goals and the project structure (Andersson et al., 2006; Dahlgaard and Dahlgaard-Park, 2006).

It has been claimed that Six Sigma enables organizations to become more ambidextrous by switching structure, act organically when being challenged by new ideas and operate mechanically in focusing on efficiency (Schroeder et al., 2008). Ambidextrous organizations manage trade-odd between conflicting goals (alignment and adaptation) through utilizing and implementing “dual structures”. In these forms of organizations while some of the business units are focusing on efficiency, other business units emphasize innovation and change (Duncan, 1976; Gibson and Birkinshaw, 2004). This dual structure enables organiza-
tions to focus on both exploitation and exploration, addressing both efficiency and innovation (March, 1991). However, the ability of Six Sigma for achieving both efficiency and innovation has been challenged from different perspectives.

First, Six Sigma is characterized under the family of process management programs (Hammer, 2002; Benner and Tushman, 2003; Evans and Lindsay, 2005). Benner and Tushman (2003) argue that the utilization of process management methodologies favors incremental (exploitative) innovation at the expenses of eliminating radical (explorative) innovation. Programs such as TQM, Business Process Reengineering and Six Sigma all focus on improving, rationalizing, and enhancing organizational processes (Hammer and Champy, 1993; Powel, 1995; Harry and Schroeder, 2000). With emphasis on process improvement and variance-reduction Six Sigma would impede product innovation and radical change.

Second, Six Sigma projects focus primarily on understanding and identification of critical characteristics to the existing customers (Harry, 1998; Dasgupta, 2003; Linderman et al., 2003; Evans and Lindsay, 2005). This specific attention to the existing customers, coupled with focus on continuous improvement efforts in organizational processes and routines may be achieved at the expense of threatening the ability of the firm to identify new customers and introduce new products and/or services. As evidenced by Benner and Tushman (2003) incremental process innovation (such as Six Sigma) are fundamentally designed to meet the needs of existing customers.

Third, as a spin-off of quality management, Six Sigma maintains a strong emphasis on setting specific goals (Linderman et al., 2003). According to Pande et al. (2000) setting a clear goal is central to Six Sigma. Customer requirements are translated into the development of Six Sigma project goals (Schroeder et al., 2008). However, this focus on specifying measurable goals for Six Sigma is in contrast with the viewpoints of the founders of quality management (Deming, 1986; Linderman et al., 2003). In that regards, one could argue that Six Sigma programs can not initiate, develop, and maintain sustainable quality systems, and can not address the core principles of quality management such as a culture of learning, continuous improvement of processes, and a system view of the organization.

Accordingly there is a need to investigate the scope, limitations, and premises of Six Sigma projects, and determine their effect on firm performance. Since Six Sigma has been categorized under process improvement programs, It is believed that looking at Six Sigma from the process management perspective could provide insight on how Six Sigma programs improve organizational processes and firm performance.

4. Research objective

The objective of this study is twofold. First, it investigates the effect of Six Sigma projects on firm innovation. Using theories from process management and innovation, the paper attempts to answer the following questions:

1. Do Six Sigma projects improve firm innovation?
2. If so, how can Six Sigma projects enhance innovation capability of a firm?

Second, the paper addresses the effect of Six Sigma on firm performance. By relating Six Sigma projects to key external variables the paper assesses the role of these environmental factors as moderating variables that can influence the effect of Six Sigma on firm performance.

5. Literature review: process management

The central theme of operations management is process management. Due to the complexity and dynamisms inherent in management of processes in the operations setting research in process management remains a challenge in operations management field (Buffa, 1980). On the other hand, the impact of internal and external sources of uncertainty and variability related to operations management complicates the management, coordination and effectiveness of processes (Klassen and Menor, 2007).

Process management has strategic and operational implication which interacts with all levels within the organization (Benner and Tushman, 2003). At the strategic level, research shows that process management programs (e.g. TQM, the Baldrige model, Business Process reengineering) positively impact business result and enhance profitability (Powel, 1995; Hendricks and Singhal, 1996; Easton and Jarrell, 1998; Das et al., 2000; Douglas and Judge, 2001; Hendricks and Singhal, 2001a,b; Kaynak, 2003). At the operational level, the transformation of input (e.g. raw material, labor) to the output (e.g. products and/or services) has been the primary focus of operations management, where it is responsible for evaluation, integration and coordination of activities that transform inputs to outputs (Silver, 2004). According to Klassen and Menor (2007) effective process management requires trade-off at both operational and strategic levels, i.e. the balance between the strategic impact of the process (long-term) vs. the operational aspect (short-term). For example, inventory management requires taking into account the cost of holding the inventory (operations) while at the same time considering the safety stock to maintain an acceptable level of customer satisfaction (strategic).

An important issue in process management is the alignment between the firm’s operations strategy and its process management trade-off (i.e. cost vs. quality). It has been argued that the ability of the firm to respond to changes in a highly dynamic and evolving market will be at risk if process management maintains a narrow and tight scope on operations. For example, if a firm focuses entirely on inventory reduction and efficiency in material handling systems while facing a highly evolving market, its ability to respond to customer demands and market changes will
be threatened. In fact, strategic alignment between market and process management is the key in process management decisions (Bower and Christensen, 1995; Klassen and Menor, 2007). This view challenges the traditional view of process management where it has been primarily dealt with reducing variability in the firm’s operations (Pannirselvam et al., 1999; Silver, 2004). Effective process management in markets where customer preferences are changing rapidly and the rate of product/service innovation is high cannot be sustained with emphasis on efficiency and variance reduction. Rather, it requires flexibility and adaptability.

The above discussion asserts that technological and organizational context moderate the effect of process management on operational (short-term) and business (long-term) objectives of a firm. Too much emphasis on process management may impede firm’s ability for innovation and responsiveness to new customers (Sterman et al., 1997). Since Six Sigma is categorized under the umbrella of process management programs, technological and organizational contexts moderate the effect of Six Sigma projects on operational and business results.

5.1. Organizational processes

With the focus of Six Sigma programs on process improvement, understanding different types of processes within a firm will provide insight on how Six Sigma and process improvement are related. Processes can be defined under three categories: Work Processes, behavioral processes, and change processes (Garvin, 1998). Work processes focus on accomplishing tasks. They can be divided into processes that produce goods/services (operational processes) and those that support them (administrative processes). Operational improvement happens when work processes are redesigned and restructured. To get the best out of work processes both operational processes and administrative processes should be improved. The next category of processes is behavioral processes. Having their roots in organizational theory and group dynamics, behavioral processes focus on behavioral patterns across the organization. Three distinguished patterns of behavioral processes are decision making, communication, and learning processes. Finally, change processes are those that deal with the sequence of activities over time. They describe how individuals, groups, and organizations act, develop and grow over time.

While work processes and behavioral processes take a static view of the organizational processes, change processes exhibit a dynamic view of the process, dealing with the patterns and dynamics of change over time. Despite the fact that gradual and incremental improvement in each type of processes is achievable, to get best of process improvement initiatives organizations need to look at the interaction and interconnectedness among these three types of the processes. For example, a significant improvement in production efficiency cannot happen without improving its supporting administrative processes, the way decisions are made in the organization (behavioral process), and understanding the nature and pattern of organizational change over time (change processes).

With reference to Six Sigma programs as a process management initiative, it appears that it has been heavily focused on improving work processes (primarily task processes). There is little understanding of the implementation of Six Sigma on improving or reshaping behavioral and change processes. In fact, there are two challenges to implement Six Sigma programs for behavioral and change processes. First, Six Sigma programs maintain a strong focus on specifying measurable and quantifiable goals (Linderman et al., 2003). While in the case of work processes (especially task processes) that might be achievable, there is little evidence on how to set specific and measurable goals for improving and/or restructuring behavioral and change processes. Second, Six Sigma programs are developed through translating the voice of customers (primarily the external customers) to specific improvement projects. Referring to different types of processes within an organization, it can be argued that task processes have the advantage of receiving the input from external customers. That is not the case with behavioral and change processes, where the voice of external customers can not be heard. In fact, such a link between the voice of external customers, and behavioral and change processes has not been established. Putting it differently, to the extent that Six Sigma projects fail to address the voice of internal customers, they fail to improve behavioral and change processes. Therefore, Six Sigma programs can not develop, maintain, and establish sustainable process improvement programs since Six Sigma programs have not been designed to integrate all processes in their process improvement efforts.

5.2. Process management and firm performance

While the proponents of process management cite numerous benefits from process improvement programs, the effect of process management on firm performance has been mixed, and has failed to yield the promising results (Benner and Tushman, 2003). Researchers have failed to find any significant relationship between process management programs and firm performance (Powel, 1995; Samson and Terziovski, 1999). In addition, while process management programs have increased performance in the auto industry, they appear to decrease performance in the computer industry (Ittner and Larcker, 1997). One could argue that process management programs are best implemented in the stable markets (e.g. auto industry) while their applicability in the evolving markets is limited (e.g. computer industry).

Most of the research on process management has been conducted under the quality management umbrella. Research in quality management and firm performance does not provide a clear answer on the effect of quality management on firm performance. Empirical studies show
that quality management practices (as an integrated process management program) increase firm performance (Hendricks and Singhal, 1996; Easton and Jarrell, 1998; Kaynak, 2003). In contrast, other studies show that implementation of quality management programs has improved operational performance in the short-term but fails to maintain it on the long-term (Sterman et al., 1997). There is no evidence that the performance of successful firms has been improved because of implementation of quality management programs; firms which had high level of performance maintained that level of performance after implementing quality management programs, and the adoption of quality management was not the main factor for maintaining their competitive advantage (York and Miree, 2004).

To address the inconsistencies in the above finding, several propositions have been made. One possible argument is that firms do not adopt all requirement of quality management and fail to fully implement it (Westphal et al., 1997; Easton and Jarrell, 1998; Zbaracki, 1998). Another explanation is the lack of fit between quality management and the culture of the firm (Sterman et al., 1997; Cameron and Barnett, 2000). Quality management failure has been also attributed to the gap between top management rhetoric about their intentions for quality and the reality of implementation in each subunit. This becomes further complicated when organizations fail to address the balance between higher control (process improvement) and high commitment and motivation for innovation (Beer, 2003).

Previous studies show that improvement programs such as quality management can present firms with a trade-off between the short-term and long-term benefits (Sterman et al., 1997). A fundamental question on process improvement is to determine whether firms emphasizing process management programs can achieve the dual goal of short-term (efficiency) and long-term (innovation) performance. Furthermore, to the extent that firms execute process improvement programs (such as Six Sigma), how are the dual goals of control (efficiency) and learning (innovation) addressed? Here, the goal is to look at Six Sigma, and determine how it can enhance the ability of the firm to achieve the paradox of control (exploitation) and learning (exploration).

6. Six Sigma as an integrated process management methodology

Research on Six Sigma has been primarily focused on anecdotal evidence and case studies (Schroeder et al., 2008). Academic research on Six Sigma has been accelerated in recent years (Linderman et al., 2003; McAdam and Lafferty, 2004). McAdam and Lafferty (2004) argue that successful implementation of Six Sigma requires attention to both process perspective (methodology) and people perspective (behavior). While early research on Six Sigma has been focused on the technical side of Six Sigma in terms of tools, techniques and methodologies, recent studies have paid attention to the psychological, contextual and human side of Six Sigma such as reward systems for Six Sigma (Buch and Tolentino, 2006), goal setting (Linderman et al., 2006), organizational context (Choo et al., 2007a), and psychological safety (Choo et al., 2007b).

Six Sigma has been traditionally focused on cost reduction and efficiency; however recent studies show that it could be used as a methodology to increase profitability (Sodhi and Sodhi, 2005), and it could drive creativity (Biedry, 2001), enhance organizational learning (Wilklund and Wilklund, 2002), and facilitate innovation (Byrne et al., 2007). In terms of performance variation, the human side of Six Sigma exhibits the highest level of variation between different groups in an organization (Fleming et al., 2005). In addition, it requires top management commitment, highly disciplined approach, and training (Hahn et al., 2000).

Different theoretical frameworks have been used to understand Six Sigma implementation. Building upon goal theory literature, Linderman et al. (2003) address the role of specifying challenging goals for Six Sigma projects, where Six Sigma projects with challenging goals result in a greater magnitude of performance. They also indicate that the use of a structured method (in Six Sigma projects) increases performance. In another study, Linderman et al. (2006) empirically show that goals can be effective when Six Sigma projects employ Six Sigma tools and methods. However, specifying unrealistic and very challenging goals are counterproductive, resulting in frustration and lack of motivation for team members.

From a knowledge management perspective, Choo et al. (2007a) develop a knowledge-based framework for Six Sigma projects. By focusing on two complementary sources of knowledge creation in Six Sigma projects – prescribed methodology and organizational context – they argue that Six Sigma projects that can make a balance between the effective implementation of prescribed methodology (e.g. tools and techniques such as quality control) and context (e.g. leadership, organizational culture, and Black Belt roles) can generate higher level of knowledge. To the extent that firms can manage such a balance, a sustainable quality advantage will be maintained.

Previous studies on Six Sigma address the role of Six Sigma as a highly structured and disciplined approach to process improvement. While there is agreement on the ability of Six Sigma on enhancing operational performance (e.g. process improvement) there is little understanding on the effect of Six Sigma on improving firm performance over time (Foster, 2007). In addition, the literature does not provide insight on the role of organizational and contextual variables on the effectiveness of Six Sigma programs.

7. Six Sigma, process management, and innovation

The development and introduction of any innovation initiative (such as Six Sigma as a process management
program) can be viewed as a mechanism for organizational adaptations since they are used or reinforced by organizations in response to environmental changes (Brown and Eisenhardt, 1997). Despite the differences among process management programs (such as TQM, Baldrige Award, Six Sigma) in terms of scope, methodology and their approach all of them have a common mission: improving organizational processes (Hammer and Champy, 1993; Ittner and Larcker, 1997; Harry and Schroeder, 2000).

Because of the focus of process management programs in variance reduction (efficiency) efforts for improving the operations and continuous improvement of activities in a firm, over-emphasis on these programs affects the balance between exploitation and exploration (Benner and Tushman, 2003). In other words, too much focus on process management will have negative effects on innovation, which may negatively affect the long-term performance of the firm (Garvin, 1991; Hill, 1993). To find the impact of process management on firm performance in both short-term and long-term, we need to take a closer look on the effect of process management on innovation.

7.1. Process management and innovation

Process management influences innovation of the firm in several ways. First, it attempts to balance the allocation of resources to activities across the firm (Christensen and Bower, 1996; Klassen and Menor, 2007). Second, process management deals with minimizing sources of variability in internal and external activities (Pannirselvam et al., 1999; Silver, 2004). This may result in focusing on specific types of innovations that are consistent with reducing variability in the processes (Henderson and Clark, 1990). That is the case with Six Sigma programs where it is aimed at innovation in design and development processes (Harry and Schroeder, 2000).

To understand the effect of Six Sigma on innovation we need to be familiar with different types of innovations. Researchers have looked at innovation from different perspectives. Innovations could affect the technological base of the firm, the subsystems/routines/procedures, and the markets/customers the firm is serving. Abernathy and Clark (1985) classify technological innovation into two dimensions: (1) the degree to which they are close to current technological path and (2) their degree of closeness to existing markets/customers. While incremental changes are built upon the current technological capabilities of the firm, by fundamentally changing the current technological base firms can exhibit radical change (Green et al., 1995). Technological innovations affect the systems and processes within a firm (Tushman and Murmann, 1998). They may affect the subsystems, routines or processes without affecting the integration and interconnectedness among processes and routines, which results in modular innovation. On the other hand, they may bring architectural innovation, change the way subsystems, routines, and procedures are linked, and totally restructure the configuration and interconnectedness among procedures and routines of the firm.

Technological innovations can also affect the market/customers the firm is serving. They may address the needs of the existing customers/markets or the new/emerging customers and/or markets (Christensen and Bower, 1996). While improvement in current technological base are suitable for addressing the needs of existing customers/market, products and/or services designed for new customers/markets need different type of technological capabilities, technologies that are fundamentally different from the current technological trajectory of the firm (Christensen, 1998). Since Six Sigma programs translate the voice of customers into independent process improvement projects, they enhance the technological innovation of the firm. Accordingly, it is proposed that

P: Six Sigma programs significantly improve technological innovation of a firm.

The key decision regarding Six Sigma programs is to determine their impact on (1) the technological base of the firm (incremental vs. radical), (2) the processes, procedures, and routines within the firm (modular vs. architectural), and (3) new customers/markets or existing customer/markets (sustaining vs. disruptive technologies).

7.2. The effect of Six Sigma on innovation and firm performance

Six Sigma programs attempt to improve the processes with the firm with the focus on reducing variability in organizational processes and routines (Linderman et al., 2003; Schroeder et al., 2008). A popular framework for Six Sigma is DMAIC which encompasses Design, Measure, Analyze, Improve, and Control phases (Hammer, 2002; Linderman et al., 2003, 2006; Knowles et al., 2005). This structured methodology helps Six Sigma programs to identify the root causes of the problem, look for solution, and improve the process.

It should be noted that in the search for improvement in organizational routines and procedures, Six Sigma efforts are primarily focused on improving efficiency within an existing technological base of the firm (Benner and Tushman, 2003). Because of the focus of process improvement programs on continuous and incremental change, they are best suited for improving the existing technological trajectory of the firm. In the pursuit of reducing variability and increasing efficiency, Six Sigma programs ensure that the new technological innovation (in processes or systems) are very close to the current technological base of the firm. Accordingly,

P: Six Sigma programs positively affect incremental innovation of the firm.

Six Sigma programs improve organizational procedures and routines. Six Sigma assumes that the current organizational processes are sound but they need minor (incremental) improvement to be efficient (Hammer, 2002). Six Sigma does not change the integrity and interconnectedness of
organizational processes; rather, it improves them. Therefore,

P2: Six Sigma programs positively affect modular innovation in the firm.

According to Douglas and Erwin (2000) Six Sigma is a concept that concentrates on the customer rather than the product. The primary target for Six Sigma improvement efforts are the existing customers. Information and data from the existing customers are collected and analyzed, and Six Sigma projects are defined to improve the processes in order to meet customer requirements. Organizations strive to reduce or eliminate the number of customer complaints received with the perceptions that fewer complaints equate to increased customer satisfaction. This will result in introducing new products and/or services which is targeted to the existing customers. Therefore,

P3: Six Sigma programs positively improve innovation for the existing customers.

Knowledge about customers’ perceptions and attitudes regarding an organization, and its products and/or services will greatly enhance its opportunity to make better business decisions. Harry (1998) states that Six Sigma’s philosophy recognizes that there is a direct correlation between the number of defects, wasted operating costs, and the level of customer satisfaction.

The focus of Six Sigma has been to address the needs of the existing customers (Linderman et al., 2003; Evans and Lindsay, 2005). Customer requirement are translated into quantifiable goals. Kwak and Anbari (2006) argue that effective implementation of Six Sigma projects requires strong customer focus. In fact, within the DMAIC process (Design, Measure, Analyze, Improve, and Control) understanding the requirements and expectations of customers needs to be addressed. Pande et al. (2000) recommend that organizations first look at the problem from the customer side when dealing with a problem. It is believed that a customer-oriented firm will focus on integrating the input from customers into its Six Sigma projects, where it will tackle projects that have the highest impact on customer satisfaction (Johnson, 2005). All of the above confirms the focus of Six Sigma on addressing the voice of the existing customers. Accordingly,

P4: Six Sigma programs improve customer satisfaction for the existing customers.

As indicated earlier Six Sigma projects focus on reducing variability of the organizational processes and routines. Organizations use Six Sigma initiatives to deal with a specific problem. In that regards, they tailor their process improvement efforts to address a specific problem raised by existing customers. In their pursuit for process improvement, organizations improve their existing products/services to meet or exceed customers’ expectation. Such incremental improvements could have two benefits for the firm; first, it improves customer satisfaction for their existing customers, and second, it could attract new customers due to the changes they have made to the products. Accordingly, at the early stage of Six Sigma implementation, firms have the opportunity to enhance their customer base through either focusing on their existing customers or addressing the needs of new customers. The challenge for the firms at their early stage of Six Sigma initiative is to whether continue their efforts on improving their existing products/services (focusing on existing customers) or restructure their existing processes (aiming at new customers). Therefore, it is expected that at the early stage of Six Sigma project organizations develop the capabilities to develop new products or services; these products could be either within the existing technological trajectory of the firm (incremental innovation) or follow an entirely new technological trajectory (radical innovation). In fact, due to the way they translate and integrate customer requirements, Six Sigma projects provide firms with a foundation to either incrementally develop their existing processes or radically change their entire processes. In that regards, as firms devote their resources and attention to improving their existing processes and routines with focus on their existing customers, they may ignore radical innovation. In other words, while at the early stage of Six Sigma firms may be motivated to restructure their processes and routines to achieve radial innovation, too much emphasis on Six Sigma projects shifts the direction of the firms to incrementally improve their current technological trajectory. Therefore,

P5: Six Sigma programs have a bi-polar effect on radical innovation of the firm. The customer orientation of the firm (existing vs. emerging customers) moderates the effect of Six Sigma on radical innovation.

Consistent with the previous proposition, Six Sigma projects (at their early stage of implementation) provide firms with the foundation to address the needs of both existing customers and the new customers (i.e. the opportunity to address process improvement and innovation). However, as organizations focus too much on Six Sigma projects, they systematically focus on the needs of their existing customer base. Therefore, one could expect that too much emphasis on Six Sigma projects may paralyze organizations to develop new products/services for their new customers. Accordingly,

P6: Six Sigma programs have a bi-polar effect on innovation for new customers. Focus on existing customers moderates the effect of Six Sigma on innovation for new customers.

The relationship among Six Sigma, innovation and firm performance has been presented in Fig. 1. Six Sigma projects have a positive effect on incremental innovation of the firm (P1). Customer satisfaction for existing customers is increased as organizations invest more on their Six Sigma projects (P2). As the result of improvement in customer satisfaction along with incremental innovation firm performance will be enhanced.

8. Six Sigma and firm performance

The degree to which Six Sigma programs are effective can be contingent upon the stability of the customer base
or the environment. When organizations are serving a specific customer base and the customer base is expected to remain stable over time, Six Sigma programs can maintain a strong focus on translating the voice of customers into improvement projects. This is due to the fact that within stable customer base, customer requirements are expected to remain stable over time. The same pattern could be envisioned within stable markets/environments. In such an environment, the rate of innovation and change is predictable, and patterns of innovation and change can be easily projected. More specifically, the focus of innovation and change is on improving organizational processes (efficiency) rather than improving new products (innovation). Petroleum industry could be a good example of a stable customer base. While the price of oil fluctuates dramatically over time, the gas stations provide standard and specific products. To improve organizational effectiveness in such an environment firms need to focus on improving their operational effectiveness to reduce the operational cost, resulting in reducing variability in their processes and procedures. In contrast, in consumer electronics new products and services are offered so frequently that requires restructuring, redesigning and reevaluating organizational processes and routines by organizations. Accordingly, it is proposed that

P7: To the extent that the customer base is stable, Six Sigma programs positively affect firm performance. In other words, customer base moderates the effect of Six Sigma programs on firm performance.

It has been shown that contextual variables such as industry structure and competition affect the implementation of process management programs (Das et al., 2000; Lai and Cheng, 2003; Zhao et al., 2004). While within evolving markets the rate of innovation and change is dramatic stable markets exhibit little change in industry structure and intensity of the competition. Constantly evolving markets require constant change in developing new products and services, where firms are forced to introduce new products and service to remain competitive. The locus of innovation in dynamic markets is product/service innovation. This inclination toward competitiveness requires exploration and learning rather than exploitation and control. In contrast, stable markets/environments are characterized by established products/services, where little attention is given to developing new products and/or services. In such environments, organizations need to focus on process improvement and efficiency rather than innovation since the sources of competitive advantage is process improvement. Therefore, it is proposed that

P8: To the extent that the environment is stable, Six Sigma programs positively affect firm performance. In other words, the environment moderates the effect of Six Sigma programs on firm performance.

9. Discussion

Effective process management programs integrate customer point of view when defining their improvement initiatives. While some of these programs (e.g. BPR) are designed to restructure internal operations of the firms others (e.g. TQM) incrementally change their operational performance (Herzog et al., 2007). Regardless of the type, scope and promise of process management programs, the fundamental difference among process management programs are the degree to which either they keep the organization’s existing core competency or provide the opportunity for organizations to pursue a new and radical technological base.

It has been argued that processes management programs such as TQM cannot provide firms with sustainable competitive advantage. Traditionally these programs have been developed to improve certain characteristics of the processes to achieve higher level of operational efficiency, with respect to the voice of customers. The arguments presented in this paper suggest that suggests that the failure of process management programs such as Six Sigma can be related to their inability to address radical innovation as well. By translating voice of customers to viable projects Six Sigma programs improve process characteristics that are critical to the customers. To be effective and yield the best results, Six Sigma programs should address the needs of both existing and future customers. However, such a focus has not been traditionally associated with Six Sigma, i.e. translating voice of the customers has been attributed to the viewpoint of existing customers.

At a more conceptual level, Six Sigma projects deal with tasks, processes and operations. As Garvin (1998) stated it appears that they are best designed to deal with task processes. Six Sigma processes cannot handle behavioral processes since these processes cannot provide any input for Six Sigma programs. Improvement in decision making, communication, and learning processes cannot be achieved with Six Sigma projects since they are designed to deal with specific, quantifiable and measurable improvement goals. In addition, Six Sigma projects fail to address the pattern and evolution of firm overtime. Effective Six Sigma implementation requires attention to all three types of processes within the organizations. Six Sigma programs have shown little evidence to assure us their capability to deal with behavioral and change processes. Therefore, radical and sustainable process improvement cannot be achieved from Six Sigma projects due to their lack of attention to behavioral and change processes.
9.1. Implication for practice

The findings of this paper will be helpful for organizations focusing on Six Sigma and improvement projects. Organizations need to develop project selection guidelines to make sure they benefit from their Six Sigma projects. This means that organizations should define their Six Sigma projects with reference to their business strategy. If the emphasis is on efficiency and reducing costs, Six Sigma projects have a very high rate of success, assuming the resources for project (human resource and capital) are secured. Project managers should expect to benefit a lot from Six Sigma projects if two conditions are met: (1) the firm (or the business unit) is focusing on efficiency and (2) the rate of change in the industry is low (stable industry). Implementation of Six Sigma projects in a highly dynamic and evolving environment with high rate of innovation and change is very risky due to the inability of Six Sigma projects in addressing radical change. Therefore, in defining and developing Six Sigma projects organizations should be careful to select projects that satisfy the above conditions.

9.2. Limitations and future research

The paper addressed the effect of Six Sigma projects on innovation and firm performance using theories from process management and innovation. It is believed that empirical research is needed to further validate the propositions. It is recommended that the type of industry (service, manufacturing), the environment (stable, dynamic) and the customer base (stable, evolving) be taken into account. In addition, the size of the organization should be considered as a control variable in future research.

One of the challenges in conducting research in Six Sigma is to clearly distinguish between Six Sigma projects and other process improvement initiatives. Organizations may refer to their process improvement programs as Six Sigma programs, where in reality they may not be true Six Sigma projects. Therefore, attention should be devoted to carefully select organizations that implement Six Sigma programs.

Another possible avenue for research is to determine the effect of other quality initiatives on the success of Six Sigma projects. The implementation of quality management programs (such as lean or the Baldrige model) provides organizations with the ability to more systematically focus on organizational processes so that they can effectively implement total quality philosophy (Dahlgaard and Dahlgaard-Park, 2006). Therefore, it would be interesting to see if there is any difference in terms of performance between organizations which have implemented other quality programs with those which only focused on Six Sigma.

10. Conclusion

Six Sigma programs have been utilized as a structured methodology to improve organizational processes. With their focus on the viewpoint of customers, they systematically translate critical-to-quality characteristics into improvement projects. While it has been argued that Six Sigma programs enable firms to become more ambidextrous through their dual focus on efficiency (exploitation) and innovation (exploration) review of the literature on process management reveals that they may impede the ability of the firm for radical innovation, forcing the firm to pursue the current technological trajectory. In addition, as firms heavily capitalize on their Six Sigma programs, their ability in indentifying, monitoring, and understanding the needs of their future customers may be paralyzed.

To get the best out of Six Sigma programs, organizations need to carefully address the needs of their current customers while monitoring the formation of new markets and/or customers. In its current form, Six Sigma programs do not guarantee a sustainable competitive advantage for the firms due to their focus on existing processes, products, and customers. This is due to the fact that they have not been developed to address radical improvement in organizational processes and routines. There is no doubt that organizations can benefit from Six Sigma programs; however, such benefits are not sustainable until Six Sigma programs develop mechanisms to address product innovation, pattern of change in customer base, and environmental uncertainty while improving organizational processes.

References

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