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Toward a theory of managing context in Six Sigma process-improvement projects: An action research investigation☆

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ABSTRACT

In this paper, field studies, extant literature, and domain knowledge are used to develop a theory of managing context in Six Sigma process-improvement projects. By means of a participatory action research investigation involving ten projects in manufacturing and service firms, this paper examines the interrelationship among project context, elements, and success. Rich text-based information for each project was analyzed for the underlying patterns and relationships using the NVIVO 8 qualitative data analysis software package. The insights gained from this in-depth field investigation are presented in the form of 12 inductively derived research propositions that, when taken together, uniquely contribute to context-based theory-building in this area.

1. Introduction

Process-improvement projects are an important cornerstone for continued business success. Of the various manifestations of these projects, Six Sigma projects present an area of active interest among manufacturing and service leaders and managers who have achieved remarkable success with their implementation. For instance, before implementing Six Sigma in late 1980s, Motorola was spending 5–20 percent of its annual revenues in correcting poor quality, which translated into a $800 million to $900 million spend each year. After implementing Six Sigma and applying its methodologies and practices, Motorola saved approximately $2.2 billion within four years. With the help of the Six Sigma approach in the early 1990s, Asea Brown Boveri (ABB) achieved a 68 percent reduction in defect levels and a 30 percent reduction in product costs, which led to $898 million in savings and cost reduction each year over a two-year period. Similarly, General Electric also attained impressive gains in earnings, operating margins, and cash flows because of Six Sigma process improvement projects (Harry and Schroeder, 2000).

Although positive results from Six Sigma projects abound, such endeavors also have received some criticism in recent years for failing to deliver performance benefits (Clifford, 2001; Richardson, 2007; Chakravorty, 2010). For instance, Richardson (2007) notes that following the announcement of Six Sigma initiatives, the stock of such firms as Home Depot, Honeywell, 3M, and GE underperformed that of the S&P 500 over a comparable time period. Chakravorty (2010) presents the experience of an aerospace company in which more than half of over 100 projects implemented at the company failed to generate lasting gains after two years.

The mixed results associated with Six Sigma process-improvement projects provide motivation for this research. Explicitly considering the important aspect of *project context*, which has received very little research attention, we intend to rigorously examine prior literature as well as create new insights through our own field investigations.

A rich stream of research in statistics and quality technology literature provides the technical foundations for quality-control issues underlying process-improvement projects. Within the operations management literature, several recent articles in academic journals have focused on theoretical issues pertaining to process improvement and identified key project elements that lead to Six Sigma project success (e.g., Linderman et al., 2003; McAdam and Lafferty, 2004; Linderman et al., 2006; Choo et al., 2007a,b; Zu et al., 2008; Schroeder et al., 2008). Project success, in turn, results in favorable business-related outcomes. Although a few studies have discussed project context variables, such as task complexity (Linderman et al., 2003) and uncertainty (McAdam and Lafferty, 2004; Ward and Chapman, 2003), a clear conceptualization of these variables is currently lacking. Further, it is not yet clear how these

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contextual variables on their own and in concert with the project management elements identified in prior literature affect project success. This study accordingly addresses the following research questions:

- What are the key contextual variables that play an important role in process-improvement projects, with a specific focus on Six Sigma projects?
- Can process-improvement projects be categorized based on their underlying context?
- What is the relationship between project context and project success?
- How do project context and project management elements together affect project success?

The literature on process-improvement projects is reviewed next. The third section presents the research design and the data characteristics, followed by the qualitative and quantitative analyses. The fourth and fifth sections present the theoretical propositions derived from the field data and provide implications of the findings. In the sixth section, the implications of the findings from the study are presented. The seventh section concludes the paper and offers directions for future research.

2. Literature review

2.1. Determinants of project success: project management elements

In one of the early studies, Murphy et al. (1974) identified 31 managerial factors related to project success, and observed that these managerial factors influence each other. Rubinstein et al. (1976) emphasized the role played by a "product champion" in the initiation, progress, and outcome of projects. Slevin and Pinto (1986) developed a conceptual framework and asserted that the success of project implementation is associated with clearly defined goals, top management support, a competent project manager and team members, sufficient resource allocation, adequate control mechanisms, adequate communication channels with feedback capabilities, and responsiveness to clients' needs. Might and Fischer (1985) related project success with the organizational structure, the level of authority delegated to the project manager, and the size of the project. Their results suggested that project success is not related to the size of a project and is only weakly associated with organizational structure. However, a strong link was observed between the level of authority entrusted to the project manager and the internal measures of project success, such as meeting budgets, time schedules, and technical performance. Shenhar (2001) and Shenhar et al. (2002) have emphasized the need to consider multiple levels of project success along with an integration of multiple managerial factors.

Building on these insights from product development projects, recent research studies in Six Sigma process-improvement projects have outlined key elements that determine project success. Choo et al. (2007a) proposed a framework in which methodological and contextual elements result in sustainable quality advantage in the form of learning (exploitative/exploratory) and knowledge (explicit/tacit). In a related empirical investigation, Choo et al. (2007b) found that using structured methods in Six Sigma projects directly influences learning behaviors, while psychological safety is positively associated with the knowledge created. Schroeder et al. (2008) subsequently proposed a model for Six Sigma projects in which improvement specialists and strategic project selection mediate the relationship between leadership engagement and structured method, which then leads to improved performance.

In concert with the research stream focusing on Six Sigma process-improvement projects, this study conceptualizes organization-level (i.e., leadership engagement and strategic project selection) and project-level (i.e., use of improvement specialists, structured methods, and psychological safety) phenomena as key managerial elements that are essential for success. In particular, leadership engagement refers to top management championing of specific Six Sigma process-improvement projects that were examined as a part of this research investigation. Strategic project selection refers to formal mechanisms employed to evaluate the feasibility and impact of Six Sigma process-improvement initiatives. Structured method considers the use of the DMAIC (Define, Measure, Analyze, Improve, and Control) approach within Six Sigma process-improvement projects, and psychological safety represents the shared belief regarding risk taking among team members, whereby they freely voice their opinion and take requisite risks whenever doing so is required for successful execution of Six Sigma projects (Edmundson, 1999). Improvement specialists refer to a team comprising professionals with certified Black Belt qualifications or equivalent competencies and employees who have substantial process knowledge and may have had Green Belt training. Project success is manifested in a variety of forms, including on-time completion, satisfying budgetary constraints, improvements in the critical dependent "Y" metrics (e.g., patient turnaround time, call response time), and financial returns from the project.

2.2. Role of project context

Context can be conceptualized in a variety of ways. Johns (2006) defines context in the form of situational opportunities and constraints that affect organizational behavior, as well as functional relationships between variables. By presenting situational opportunities or by creating constraints, context can play an important role in organizations as well as in project management.

We have identified complexity and uncertainty as the two core dimensions of project context because they affect the knowledge created and the actions taken in a project (Hällgren and Maaninen-Olsson, 2005). In line with the insights of Pavlak (2004), at times a process-improvement project may require an adaptive problem-solving approach rather than a hierarchically driven structured method, especially when complexity and uncertainty are present. In such instances, project participation that is not governed by an underlying hierarchy and involves open and critical reflection, communication, and transparency enhances the knowledge base of the project and helps in its successful execution (Cicmil, 2005). Process-improvement projects typically have somewhat blurred boundaries between the project and the environment (Ekstedt et al., 1999). Therefore, in such circumstances, exploration (March, 1991) by means of flexibility of methods and project structure may be required to ensure project success. Hirschhorn (1997) also argued for changing the single-minded pursuit of predetermined explicit goals in projects faced with uncertainties. In such situations, a narrow definition of the core identities of the projects, as well as limited scope for creative thinking and problem solving, can lead to maladaptation (Brown and Starkey, 2000).

It is important to note that unlike Choo et al.'s (2007a) work in quality programs, the conceptualization of context as operationalized in this study does not aim to make the distinction between methodological and contextual elements. Instead, the objective is to position all managerial elements associated with Six Sigma process improvement as a comprehensive set. The contextual variables of complexity and uncertainty are manifestations of the situational variables within Six Sigma process-improvement projects (Johns, 2006).