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Performance effects of early and late Six Sigma adoptions

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ABSTRACT

Operations managers confront the challenge of deciding when to implement various administrative innovations such as Six Sigma, ISO 9000, and Lean. This research examines the operating performance effects of early versus late adoption of Six Sigma process improvement. Using theories of organizational learning and knowledge transfer, we develop hypotheses describing the advantages of late adoption, and factors that affect a firm's ability to benefit from Six Sigma either as an early or late adopter. We test our hypotheses using an event study methodology. The empirical results show that, on average, late adopters in our sample enjoy significantly greater performance gains than early adopters. However, the analysis also shows that the advantages of late adopters tend to be moderated by certain environmental and structural characteristics of a firm. Specifically, late adoption has been favorable when firms operate in low-velocity industries, when they primarily sell in business-to-business markets, when they have good financial performance prior to adoption, and when they are large. Conversely, when adopters operate in conditions that have the opposite characteristics, then early adoption appears to have produced better results. Understanding the effects of these factors can enhance managers' abilities to determine appropriate adoption timing to increase performance.

1. Introduction

Managers continuously search for administrative innovations that can potentially improve their business processes and enhance operating performance. Defined by Teece (1980, p. 464) as "improvements in administrative techniques and in the organization of economic activity", administrative innovations include practices such as quality management, matrix management, and zero-based budgeting (Westphal et al., 1997), and certifications such as ISO 9000, ISO 14000, and C-TPAT (Ritchie and Melnyk, 2012). In this study, we focus on Six Sigma as an administrative innovation. While managers search for new administrative innovations like Six Sigma to improve performance, they face advertisements and proposals from vendors, business consultants, and other purveyors of such improvement methodologies. In a fast moving world, managers have to decide whether, when, and how they should adopt new innovations. Such decisions can significantly impact an organization's competitive standing, because they affect the organization's ability to maintain parity or even create advantages over competitors. This study examines the important question of *when* to adopt administrative innovations by studying the impacts of early and late adoption of a widely diffused innovative program, Six Sigma.

Administrative innovations like Six Sigma typically require major reassignments of tasks and responsibilities across an organization; they can therefore be expensive and disruptive to adopt (Teece, 1980). Accordingly, researchers have examined whether such innovation adoptions lead to operating performance improvements that exceed these investments. Examples include studies of the performance effects of TQM (Yeung et al., 2006), ISO 9000 (Corbett et al., 2005), JIT (Kinney and Wempe, 2002), and Six Sigma (Swink and Jacobs, 2012; Shafer and Moeller, 2012). On the whole, these studies found that the decision to adopt administrative innovations yields significant performance benefits. However, the benefits may vary depending on *when* organizations decide to adopt the administrative innovation. Importantly, the ease and effectiveness of implementation may be influenced by the adoption timing. Administrative innovations may be more difficult to implement during early stages of diffusion, since little experience or knowledge has accumulated to guide adoptions. Without such knowledge, organizations rely on learning-by-doing, which

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proceeds at a slower pace (Aldrich and Ruef, 2006). A substantial portion of the literature describing the diffusion of innovations contrasts the motivations of early and late adopters of such practices (e.g., Rogers, 2003). However, few studies have directly examined the operating performance effects of early versus late adoption. In this article, we extend the arguments for early versus late adoption of administrative innovations in order to develop and test hypotheses that describe performance effects associated with the adoption timing of Six Sigma process improvement programs.

Administrative innovations such as JIT manufacturing and Six Sigma have no externally defined standards and no external agencies that certify adopting organizations to established norms or standards. Such administrative innovations are not strictly defined. They are typically diffused through the documented experiences of early and exemplary adopters. Organizations therefore have great latitude in how they adopt and implement the innovation. Innovation implementation examples, such as those provided by early Six Sigma adopters, can guide later adopters by serving both as referents and persuaders (Jensen and Szulanski 2007). Referents permit later adopters to observe implementation details and nuances. Persuaders help to convince managers and employees of late adopters by providing physical proof of adoption benefits. As Williams (2007) explains, successful knowledge transfer requires both replication due to the ambiguity of the knowledge, and adaptation because knowledge is context dependent. Accordingly, adopters will customize their adoptions (if possible) to best fit their organizational contexts.

Early adopters are typically thought to enjoy certain *first mover advantages* which produce superior financial outcomes (Lieberman and Montgomery, 1988). Such advantages include early access to limited information, head starts on experience curves, buyer lock-ins due to switching costs, and brand equity derived from positive customer perceptions of the firm's technological leadership (Lieberman and Montgomery, 1988; Kerin et al., 1992; Frynas et al., 2006). In addition, early adopters might enjoy greater benefits since they likely adopt for efficiency reasons rather than the normative, mimetic, and coercive pressures that late adopters are more subject to (Westphal et al., 1997; Guler et al., 2002; Benner and Veloso, 2008). On the other hand, early adopters face greater uncertainties about the applicability of the innovation, and have less knowledge on how to effectively implement it. Because late adopters of Six Sigma have access to more knowledge and experience that has accrued for the innovation, they can make more appropriate adoption decisions, and better determine which components of the innovation to replicate and which to adapt to their local contexts. Thus, we expect that late adopters should experience *late mover advantages* over early adopters. Importantly, environmental and structural factors may limit or enhance late adopters' abilities to effectively implement innovative processes. For example, late adopters in stable environments might be more successful at implementing the innovation than late adopters in dynamic environments. Firms in a stable environment can better apply the knowledge and experience gained from earlier periods to their more predictable setting, thus making improved adoption, replication, and adaptation decisions.

Six Sigma has diffused to a wide variety of industries, and a large literature documents its growth. Six Sigma adoptions often involve large investments in training, consulting support, reorganizations, and associated information systems. A number of case studies, anecdotes, and small sample studies describe adoption success factors (Goh et al., 2003; Zu et al., 2008; Gutiérrez et al., 2009; Braunscheidel et al., 2011), but rigorous studies of performance effects are only now emerging (Swink and Jacobs, 2012; Shafer and Moeller, 2012). Given the evidence that Six Sigma adoption is beneficial to operating performance, our study provides further insights on benefits of adoption timing, and contingencies that moderate these benefits.

In a larger theoretical sense, the findings of our study show that, on average, late adopters of Six Sigma enjoy significantly greater performance gains than early adopters, suggesting that the growth of supportive knowledge resources over time confers advantages upon late adopters. However, the analysis also shows that the advantages of late adopters tend to be moderated by certain environmental and structural characteristics of a firm. Namely, late adoption has been favorable when firms operate in low-velocity industries, when they primarily sell in business-to-business markets, when they have good financial performance prior to adoption, and when they are large. Conversely, when adopters operate in conditions that have the opposite characteristics, early adoption appears to have produced better results. We explain how understanding the effects of these factors may serve to enhance managers' abilities to determine appropriate adoption timing to increase performance benefits.

2. Six sigma adoption and timing

2.1. Six sigma adoption

Schroeder et al. (2008, p. 540) defines Six Sigma as "an organized, parallel-meso structure used to reduce variation in organizational processes by employing improvement specialists, a structured method, and customer-oriented performance metrics with the aim of achieving strategic objectives." Schroeder et al. (2008, p. 540) note that "companies may choose variations of this base definition when implementing Six Sigma in order to customize it to their situation." Implementing Six Sigma typically involves the creation of an authority structure, dispersed and specialized training efforts, and a cross-functional project execution hierarchy. Its core elements include a structured method, a focus on variance reduction, and a combination of both general and specific performance metrics oriented to customers.

Many organizations have adopted Six Sigma, including most Fortune 500 companies (Nakhai and Neves, 2009). High profile firms including Motorola, General Electric, and Honeywell helped to promote and legitimize the approach. The growth of Six Sigma has spawned a large literature and supporting knowledge infrastructure for late adopters of the practice. Dozens of books are devoted to the topic, and a large consulting base has emerged. Adoptions usually involve large resource expenditures, and they can provide significant returns. As an example, General Electric purportedly spent upwards of $1.6 billion on Six Sigma during 1996–1999 (Feng, 2008). Related training costs as high as $50,000 for each trained worker have been reported (Antony, 2006; Fahmy, 2006). Numerous successes and failures have been recorded. A recent study of 214 adopting firms documented an average 4-year post-adoption increase in abnormal ROA of 0.83% (Swink and Jacobs, 2012).

Administrative innovations such as Six Sigma affect the ways that organizational members conduct their routine work (Sinha and Van de Ven, 2005). Several researchers note that studies of the diffusion of administrative innovations have tended to treat them as being homogeneous, neglecting practice variation over time (Cool et al., 1997; Ansari et al., 2010). In reality, practices evolve over time as various organizations adapt and reconfigure them to meet their specific needs and contexts (Robertson et al., 1996; Rogers, 2003; Strang and Kim, 2004). As noted above, successful knowledge transfer comprises both replication of discrete elements and adaptation of context dependent elements (Williams, 2007). While the foundational elements of the Six Sigma template are identifiable, distinct, and might be considered discrete, the literature provides