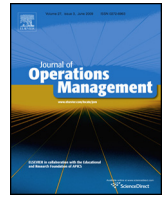




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# Lean manufacturing and firm performance: The incremental contribution of lean management accounting practices



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## ABSTRACT

Manufacturing firms operating in rapidly changing and highly competitive markets have embraced the continuous process improvement mindset. They have worked to improve quality, flexibility, and customer response time using the principles of *Lean thinking*. To reach its potential, lean must be adopted as a holistic business strategy, rather than an activity isolated in operations. The lean enterprise calls for the integration of lean practices across operations and other business functions. As a critical component for achieving financial control, management accounting practices (MAP) need to be adjusted to meet the demands and objectives of lean organizations. Our aim is to help both researchers and practitioners better understand how lean MAP can support operations personnel with their internal decision making, and operations executives and business leaders in their objective of increasing lean operations performance as part of a holistic lean enterprise strategy. We use survey data from 244 U.S. manufacturing firms to construct a structural equation model. We document that the extent of lean manufacturing implementation is associated with the use of lean MAP, and further that the lean MAP are related in a systematic way: simplified and strategically aligned MAP positively influences the use of value stream costing, which in turn positively influences the use of visual performance measures. We also find that the extent of lean manufacturing practices is directly related to operations performance. More importantly, lean manufacturing practices also indirectly affect operations performance *through* lean MAP. These findings are consistent with the notion that lean thinking is a holistic business strategy. In order to derive the greatest impact on performance, our results indicate that operations management cannot operate in a vacuum. Instead, operations and accounting personnel must partner with each other to ensure that lean MAP are strategically integrated into the lean culture. In sum, lean MAP provide essential financial control that integrates with and supports operations to achieve desired benefits.

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## 1. Introduction

Manufacturing firms operating in the rapidly changing and highly competitive market of the past two decades have embraced the principles of *Lean thinking*. In doing so, they reorganize into cells and value streams to improve the quality, flexibility, and customer response time of their manufacturing processes. Decisions previously made by managers are instead made by those teams close to the work processes. The organization is transformed from a traditional structure characterized as top-down with project-driven improvement led by middle managers into one where

continuous improvement is conducted throughout the company by locally empowered teams. This change in manufacturing strategy is associated with increased operational efficiency and effectiveness, which positively impacts firm performance (e.g., Fullerton and Wempe, 2009; Hofer et al., 2012; Kaynak, 2003; Yang et al., 2011).

The Shingo Prize, which awards world-class companies for their adherence to lean principles, evaluates companies that have achieved a “cultural transformation through the integration of principles of operational excellence across the enterprise and its value stream to create a complete, systemic view, leading to consistent results” (Shingo Prize, 2010, 5).<sup>2</sup> It supports lean as an

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<sup>2</sup> The Shingo Prize is an annual award that recognizes operational excellence. It is based on the lean management approach and model taught by Dr. Shigeo Shingo, and is awarded to companies per their effectiveness in transforming their organizations through the application of specific lean principles, systems, and tools. Those principles, systems, and tools are carefully outlined in a set of guidelines,

integrated, complex management system that spans the entire company (Ahlstrom and Karlsson, 1996), where all people at all levels have to be involved and committed to continuous improvement (Furlan et al., 2011). As a holistic business strategy, lean thinking, thus, encompasses a change in mindset that extends beyond operations. In particular, management accountants should be part of the lean transformation team since they are charged with supplying operations personnel and executives accurate, appropriate, and timely internal information. As a critical support function, lean management accounting practices (MAP) provide the financial control essential for internal decision making in lean organizations. An empirical question that has not been clarified is the role lean MAP have in a lean manufacturing environment and whether operations management need to be concerned with the implementation of lean accounting practices. The purpose of this study is to shed insights on these issues.

In this study, we use three components to represent lean MAP: value stream costing (VSC), simplified and strategic MAP, and visual performance measures. We develop hypotheses predicting that lean manufacturing positively influences lean MAP, and that there is a systematic structure among the lean MAP. We also hypothesize that the lean MAP positively influence operations performance, which in turn, positively influences financial performance. We control for the direct effect of the extent of lean manufacturing implementation on operations performance in order to sort out the performance effects due to the lean manufacturing implementation versus the lean MAP.

We examine our hypotheses using a structural equation model populated with survey data from 244 U.S. manufacturing firms. Not surprising, we find that the extent of lean manufacturing implementation is positively related to lean MAP and operations performance. We further find that lean MAP are related in a systematic way: simplified, strategic MAP positively influences the use of VSC, which in turn, positively influences the use of visual performance measures. In addition, the use of visual performance measures positively influences operations performance, and in turn, financial performance. Thus, simplified, strategic MAP and VSC indirectly influence operations performance (and subsequently, financial performance) through the use of visual performance measures. What is new and interesting is that after accounting for the effect of lean manufacturing on operations performance, lean MAP also positively influence operations performance. Moreover, some of the effects of lean manufacturing practices on operations performance are translated *through* lean MAP.

Our findings expand lean understanding for researchers and practitioners in two key ways. First, we provide some of the initial empirical evidence of the relationships among lean MAP, operations performance, and financial performance. Thus, we respond to calls by Ahlstrom and Karlsson (1996) and van der Merwe and Thomson (2007) to provide empirical research that investigates if and how lean MAP integrate with operations. Second, and most importantly, we contribute by providing a more complete look at how a holistic lean strategy can enhance firm performance (see Camacho-Minano et al., 2013). Our results support prior evidence that firms can increase their operations and financial performance by implementing lean manufacturing. Further, our results suggest that firms can leverage their returns from a lean manufacturing strategy by also implementing lean MAP. This implication is consistent with researchers and practitioners who have argued that traditional MAP motivate behaviors detrimental to the success of lean because of their focus on cost reduction rather than process improvement and customer value, and, thus, need to be updated to

reflect the strategic objectives inherent to lean manufacturing (e.g., Ahlstrom and Karlsson, 1996; Chiarini, 2012; Johnson and Kaplan, 1987; Li et al., 2012; Maskell et al., 2012; Ruiz-de-Arbulo-Lopez et al., 2013). We show that strategically integrating both lean manufacturing and lean MAP provides a greater return to the firm (in the form of increased operations and financial performance) than does the implementation of only a lean manufacturing strategy, consistent with the notion that lean is a holistic business strategy (e.g., Camacho-Minano et al., 2013). This finding suggests that operations management should not implement a lean strategy solely on the manufacturing floor. Rather operations managers need to partner with accounting personnel to ensure that lean MAP such as value stream costing (VSC) and visual performance measures are implemented in support of the lean manufacturing processes. This will result in more positive effects on operations performance, and in turn, financial performance.

The remainder of this paper is organized as follows. Section 2 develops the hypotheses and discusses the related literature. Section 3 outlines the research study, and Section 4 discusses the results. Finally, Section 5 provides a summary of the study, limitations, and suggestions for future research.

## 2. Literature support and hypotheses development

Lean thinking is arguably the most important strategy for achieving world-class performance. Womack et al. (1991) first coined the term “Lean production” in their seminal book, *The Machine that Changed the World*. However, the origin of lean thinking is generally attributed to Toyota, whose production system was originally referred to as just-in-time (JIT), but is now commonly called the Toyota Production System (TPS). Lean thinking emphasizes excellence through the elimination of waste and a focus on continuous improvement. Referring to JIT/TPS, Schonberger, 1987, 5) called lean “the most important productivity enhancing management innovation since the turn of the century.” Prior empirical research has often linked lean manufacturing to operational (e.g., Cua et al., 2001; Hallgren and Olhager, 2009; Narasimhan et al., 2006; Shah and Ward, 2003) and financial (e.g., Fullerton et al., 2003; Fullerton and Wempe, 2009; Hofer et al., 2012; Kaynak, 2003; Kinney and Wempe, 2002; Yang et al., 2011) performance.

### 2.1. Literature support

Lean is most well-known as a manufacturing system, but many argue that to be successful it has to be applied much more broadly as a complete business system (Grasso, 2005; Kennedy and Widener, 2008; McVay et al., 2013; Solomon and Fullerton, 2007; Womack and Jones, 1996). The essence of lean thinking is that all business processes and functions integrate into a unified, coherent system with the purpose of using lean principles and tools to provide better value to customers through continuous improvement and elimination of waste (Grasso, 2005; Shingo Prize, 2010). Since all business processes are interrelated, some argue that lean manufacturing cannot operate in isolation to realize its potential (Maskell and Kennedy, 2007).

Empirical research has taken steps in examining the holistic strategy. In their longitudinal study of core operations and human resource management practices in British manufacturing firms, de Menezes et al. (2010) find that firms with integrated advanced manufacturing practices consistently outperform others. Moreover, a 2006 Aberdeen study (Aberdeen Group, 2006) reported that there was a large performance gap between those manufacturing firms that had applied lean practices solely on the shop floor, as opposed to those that had developed a lean culture throughout the organization. In their case study, Benders and Slomp (2009)

which experienced Shingo examiners use to determine the selection of Shingo Prize recipients. The website for the Shingo Prize is [www.shingoprize.org](http://www.shingoprize.org).

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