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The Inner Dynamics and Long-term Value Creation Potential of Operational Excellence

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by

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Abstract

Operational excellence is an executional competency that reflects a firm's ability to run its day-to-day operations efficiently, effectively, and profitably. Differing views have been expressed regarding the inner dynamics and value creation potential of operational excellence. From an inner dynamics perspective, the competency's dimensions of efficiency and effectiveness are viewed by some as conflicting and difficult to reconcile (the tradeoff model), and by others as synergistic and mutually supportive (the cumulative model). From a value creation perspective, operational excellence is portrayed by some as an effective cash-flow generator and a potent enabler of firm growth, and by others as a source of excessive routinization that hinders strategic adaptation and limits long-term value creation. The present dissertation revisits these conflicting views.

Drawing on Porter's profit maximization prescription, essay 1 empirically examines the individual and collective effects of operational efficiency and operational effectiveness on firm profitability. In so doing, it assesses the respective merits of the tradeoff and cumulative perspectives. Empirical findings based on a multi-industry panel of 595 public US manufacturing firms provide relative support for the cumulative perspective; concurrent improvements in efficiency and effectiveness are shown to have a compounding positive effect on firm profitability. The findings also show that the individual benefits of isolated improvements to either efficiency or effectiveness tend to be curvilinear with diminishing returns.

Addressing the value creation question, essay 2 draws on signaling theory to empirically examine the stock market's ex-ante assessment of operational excellence as an instrument for long-term value creation. Contrary to the productivity dilemma narrative, empirical results show that market participants tend to have a positive outlook on the value creation potential of

operational excellence. The positive outlook is, however, found to be dampened by the stock market's expectations of firm short-term revenue growth and amplified by firm R&D efforts.

In a third exploratory essay, I discuss environmental and organizational learning factors that have the potential to cause firms to grow overinvested in operational excellence at the expense of strategic foresight and market adaptation. Essay 3 is conceptual in nature and provides theoretical propositions for future empirical investigation.

Table of Contents

I. Introduction

Operational excellence is a short-term performance indicator that reflects a firm's ability to run its day-to-day operations efficiently, effectively, and profitably (e.g., Kaplan and Norton, 2008; Mentzer et al., 2008; Treacy and Wiersema, 1993). Differing views have been expressed regarding the inner dynamics and value creation potential of operational excellence.

From an inner dynamics perspective, two views stand out in the literature: the tradeoff model and the cumulative perspective. The tradeoff model suggests that operational efficiency and operational effectiveness are conflicting and difficult to reconcile, making it unlikely that firms outperform on both dimensions simultaneously (e.g., Skinner, 1969; Brumme et al., 2015). This tradeoff perspective contends that a pragmatic operations strategy is to seek excellence in one dimension while maintaining the other at or above a critical threshold (Wheelwright and Bowen, 1996). The cumulative perspective, on the other hand, argues that operational efficiency and operational effectiveness might be difficult but not impossible to reconcile (Ferdows and De Meyer, 1990). Invoking the superior performance of Japanese manufacturers on both dimensions, proponents of the cumulative perspective argue that operations strategy should facilitate the simultaneous improvement of both efficiency and effectiveness (e.g., Clark, 1996; Flynn and Flynn, 2004; Heim and Peng, 2010). Essay 1 joins this debate and investigates the individual and collective effects of operational efficiency and operational effectiveness on firm profitability. The idea is to determine whether there are limits to focused strategies that aim to maximize one competency – either efficiency or effectiveness – while maintaining the other at or above a critical threshold; and evaluate if a simultaneously superior performance on both competencies can compound firm profitability. Finding empirical support for either conjecture would strengthen the cumulative perspective and weaken the tradeoff model, and vice versa.

Based on a panel dataset of 595 US public manufacturing firms and 2,758 firm-year observations, essay 1 shows that isolated improvements to either efficiency or effectiveness do indeed result in capped profitability benefits when analyzed across the entire sample; the profit impact of improving either competency while holding the other constant is found to be curvilinear with diminishing returns. Alternatively, improving both competencies simultaneously is shown to have a strictly positive impact on firm profitability, in an indication that firms can not only improve both efficiency and effectiveness simultaneously but can do so profitably as well. The two findings provide relative support for the cumulative perspective over the tradeoff model. However, as I will discuss in detail further into the dissertation, these results may change more or less significantly as one looks into specific industries individually.

The second thrust of this dissertation concerns the long-term value creation potential of operational excellence. Differing perspectives exist in this regard as well. On the one hand, the productivity dilemma literature argues that operational excellence, despite being beneficial in the short term, is likely to induce routinization dynamics that hinder strategic adaptation and limit long-term value creation (Adler et al., 2009; Benner and Tushman, 2003). On the other hand, empirical evidence from the finance and operations management literatures seem to collectively indicate that operational excellence can be an effective cash-flow generator and a potent enabler of firm growth and long-term value creation (Fullerton et al., 2003; Myers 1984).

Essay 2 of this dissertation revisits this contentious relationship by investigating the stock market's ex ante assessment of operational excellence as an instrument for long-term value creation. Drawing on signaling theory (Spence, 1973), essay 2 is premised on the idea that operational excellence signals embedded in financial statements and accompanying notes will inform the stock market's assessment of long-term value creation. A key argument is that stock market participants will, contrary to the productivity dilemma narrative, view operational excellence as a positive signal for long-term value creation. This positive assessment is, however, hypothesized to be contextual and contingent on two factors: (a) the market's expectation of firm short-term revenue growth and (b) the firm's research and development efforts. Firm revenue growth expectations are suggested to have a dampening effect on the market's positive assessment whereas firm R&D efforts are expected to have an amplifying effect. Empirical results from a panel of 864 publicly traded manufacturing firms in the US and 3,128 firm-year observations over the 2010-2015 time period provide support for the hypothesized relationships.

A third thrust of this dissertation is to identify conditions under which the pursuit of operational excellence can cause firms to become overinvested in a narrow set of operations management capabilities at the expense of strategic foresight and market adaptation. This exploratory effort is inspired by the productivity dilemma argument suggesting that operational excellence is most beneficial under stable market conditions (Benner and Tushman, 2003). Drawing on the organizational learning literature, the central argument in essay 3 is that a firm's pursuit of operational excellence may be so effective under stable market conditions that it causes organizational sense-making to grow biased towards an exaggerated association between existing operations management capabilities and competitive advantage. Market stability is argued to serve as a double-edged sword that, on the one hand, provides an ideal environment for the successful leverage of operations management capabilities and associated operational excellence and, on the other, causes firms to become overinvested in a narrow set of such capabilities with negative ramifications on firm strategic foresight and market adaptation.

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II. Essay 1 – Tradeoff or synergy: The individual and collective effects of efficiency and effectiveness on firm profitability

Abstract

This research explores the inner dynamics of operational excellence by investigating the individual and collective effects of operational efficiency and operational effectiveness on firm profitability. Joining a longstanding debate between the tradeoff and cumulative perspectives, I draw on Porter's profit maximization prescription to explore the merits of each. Proponents of the tradeoff perspective argue that firms may not be able to reconcile efficiency and effectiveness and that a focus on one or the other is necessary to achieve operations-based competitive advantage. Supporters of the cumulative perspective, on the other hand, contend that the tradeoff model may be presenting a false dichotomy; they argue that firms have grown substantially less constrained to sacrifice one competency in the pursuit of another. Based on a large panel of 595 US public manufacturing firms and 2,758 firm-year observations, the study's empirical results suggest that most manufacturers can indeed enhance efficiency and effectiveness simultaneously – with a compounding positive effect on firm gross margin profitability. The findings also show that the individual benefits of efficiency and effectiveness are capped when analyzed across the entire sample but more nuanced when studied within individual industries. Implications for research and practice are discussed.

Introduction

For a long time, mainstream thought in operations strategy advocated a focus on either efficiency or effectiveness as a means to achieve operations-based competitive advantage (Skinner, 1969). This tradeoff perspective suggested that firms were unlikely to simultaneously outperform the competition on both efficiency and effectiveness and that a pragmatic strategy was to seek excellence in one competency while maintaining the other at or above a critical threshold (Wheelwright and Bowen, 1996).

Numerous studies have since been conducted, and alternative perspectives have emerged. In their study of European manufacturers, Ferdows and De Meyer (1990) proposed that efficiency and effectiveness may not be as systematically conflicting as once thought; they showed that the two competencies can in fact be mutually supportive such that improving one induces a sequential improvement in the other. The finding spurred discussions that proper operations strategy may not be one that seeks focused excellence in either efficiency or effectiveness, but one that cumulatively facilitates superior achievements on both (e.g., Heim and Peng, 2010).

Research on which of these two perspective holds a higher promise remains inconclusive. The largest meta-analytic work to date on the tradeoff and cumulative perspectives indicates that results are too conflicting to draw definitive conclusions (Rosenzweig and Easton, 2010). The same work shows that most of the extant literature addressing the merits of each perspective is cross-sectional, survey-based, and draws on key respondents' perceptions rather than objective measures of efficiency and effectiveness (e.g., Boyer and Lewis, 2002). Rosenzweig and Easton (2010) called for longitudinal, objective-measure studies that could help advance the debate on the inner dynamics of operational excellence as it pertains to efficiency and effectiveness. This study responds to that call by investigating the merits of the tradeoff and cumulative perspectives, respectively, in a longitudinal setting. The study also departs from the survey-based, perceptual approach traditionally used in similar research and relies on objective, accounting-based measures of efficiency and effectiveness instead.

To assess the merit of each perspective, I draw on Porter's (1996) profit maximization prescription. Porter (1996) argues that the pertinence of a firm's operations strategy is not determined by whether the strategy facilitates excellence in efficiency, effectiveness, or both; but by the extent to which the resulting operational achievements translate into profitability. As such, I empirically investigate the individual and collective effects of efficiency and effectiveness on firm profitability. The goal is to 1) determine whether there are limits to focused strategies that aim to maximize one competency – efficiency or effectiveness – while maintaining the other at or above a critical threshold; and 2) evaluate if a simultaneously superior performance on both competencies can compound firm profitability.

I develop hypotheses in support of both conjectures and empirically test them on a large panel of US public manufacturing firms over the 2010-2015 period. Using inventory efficiency and supply readiness as key indicators of efficiency and effectiveness respectively, this research provides evidence that the individual profit benefits of efficiency and effectiveness are indeed capped when analyzed at the sector-level – i.e., across the entire manufacturing sector – but more nuanced when looked at within individual industries. Empirical findings also show that most manufacturers experience a compounded positive effect on firm profitability when they enhance inventory efficiency and supply readiness concurrently. Collectively, these results provide evidence that efficiency and effectiveness have the potential to synergistically benefit firm profitability – in an indication that there may be untapped potential in the cumulative perspective's prescription.

This research contributes to the operations strategy literature in several ways. First, it assesses the financial performance implications of the efficiency-effectiveness duality, thus empirically evaluating the merits of the tradeoff and cumulative perspectives. In so doing, it builds on and adds to prior research evaluating the feasibility of concurrent improvements in efficiency and effectiveness. Second, the study reinforces the cumulative perspective's proposition that firms can indeed improve profitability by enhancing both efficiency and effectiveness simultaneously. This is of particular significance given that many firms still design their operations for focused excellence in either efficiency or effectiveness on the premise that "few unfocused factories outperform competitors" (Brumme et al., 2015, p. 1513). Third, this research provides a longitudinal perspective to the study of tradeoffs in operations strategy, thus augmenting the various cross-sectional studies on the subject (Boyer et al., 2005). Fourth, it answers Rosenzweig and Easton's (2010) call for research that uses objective measures of efficiency and effectiveness as an alternative to the more commonly used self-report, perception-based approach.

From a managerial perspective, the study highlights the benefit of adopting an all-encompassing approach to operations strategy where the goal is not to achieve focused excellence in either efficiency or effectiveness, but to enable superior profitability through a proper combination of the two competencies. It also provides managers with a simple metric (i.e., operational ambidexterity) to track the extent to which their firm's operations strategy strikes a healthy balance of efficiency and effectiveness.

Background and hypotheses

The role of operations strategy is to devise and implement organizational processes and managerial policies that facilitate the efficient and effective execution of firm competitive strategy (Boyer et al. 2005). Efficiency and effectiveness support firm competitiveness in two distinct ways. The former enhances cost containment and pricing flexibility; the latter enables service differentiation and customer value creation (Heikkila, 2002). Although both competencies are required for the proper fulfillment of a firm's value creation and value appropriation mandates (Sirmon et al., 2007), research and practice indicate that most firms design their operations to maximize one or the other (Parmigiani et al., 2011).

The pervasiveness of this selective approach to operations design is due to two factors: the primacy of focus when formulating a business-level strategy, and the subordination between business-level and functional strategies (Wheelwright, 1984). From a strategic focus perspective, it is recommended that firms define and pursue key competitive priorities rather than try to be excellent at everything at once. Clark (1996, p.45) suggests that "in every business, firms must meet minimum standards on all dimensions of customer choice in order to participate effectively. But firms that try to do everything exceptionally well and fail to develop competitive priorities will end up second-best compared to those firms that concentrate their efforts." Business-level strategic focus is often viewed as a hallmark of the disciplined organization and a prerequisite for competitive advantage (Clark, 1996).

From a subordination perspective, firms typically formulate strategic plans in a layered fashion whereby competitive priorities defined at the business-level (a.k.a. competitive strategy) dictate the scope and content of subordinate functional strategies such as operations strategy. At the business level, strategizing consists in defining higher-level competencies that need to be cultivated in order to position a business for success within a wider competitive landscape (Schendel and Hofer, 1979). At the functional level, strategizing consists in developing and aligning key capabilities that facilitate the attainment of the overarching competencies delineated at the business level (Hambrick, 1980).

Various typologies of business-level strategy have been proposed over the years (e.g., Schendel and Hofer, 1979; Miles and Snow, 1978; Wissema et al., 1980). The most studied in the literature and recognized in practice remains Porter's (1980) classification of generic strategies (Gupta and Lonial, 1998). Porter suggests that firms may obtain a competitive advantage by properly implementing one of two strategies: product/service differentiation or cost leadership. Depending on which strategy a firm pursues, a greater emphasis may be placed – at the operations level – on either efficiency or effectiveness. Firms that pursue product/service differentiation are likely to aim for excellence in effectiveness as a means to create superior customer value whereas those pursuing cost-leadership will tend to go after excellence in efficiency as a means to offer competition-comparable value at a lower cost.

While recognizing the primacy of focus at the business level, recent scholarship in operations strategy suggests that such focus need not trickle down to the functional level (Rosenzweig and Easton, 2010). With the proliferation of sophisticated process management practices (e.g., Total Quality Management, Just-In-Time) and advanced manufacturing techniques (e.g., Computer Aided Manufacturing), operations management scholars argue that firms are significantly less constrained to sacrifice efficiency to improve effectiveness, or vice versa (e.g., Blackburn and Scudder, 2009). It is argued that the traditional tradeoff between the two competencies is no longer systematic (Heim and Peng, 2010) and that firms have greater flexibility to design their operations for varying combinations of efficiency and effectiveness

(Brumme et al., 2015). The question is no longer one that asks how to maximize efficiency or effectiveness in support of a higher-level business strategy, but one that asks what combination of the two competencies to aim for in order to maximize firm profitability (Porter, 1996).

In the following subsections, I develop a series of hypotheses regarding the individual and collective effects of efficiency and effectiveness on firm profitability. Individual-effect hypotheses address the marginal profit impact of each competency (efficiency and effectiveness) holding the other constant, in line with scenarios where firms pursue excellence in one competency while maintaining the other at or above a critical threshold. The collective-effect hypothesis addresses the impact of various combinations of efficiency and effectiveness (i.e., various levels of Operational Ambidexterity) on firm profitability.

Efficiency (Inventory Efficiency)

Efficiency is generally defined as the ratio of benefits received to resources expended (Bordoloi et al., 1999). In operations management, it is construed as a system's output-to-input ratio (Priem and Butler, 2001; Ross and Droge, 2004). A versatile performance indicator, operational efficiency has been adapted "in multiple ways to reflect the range of inputs and outputs that are of interest to stakeholders involved in the system" (Ding, 2014, p. 2). Prior research explored such variations as inventory efficiency (Eroglu and Hofer, 2014), production efficiency (Modi and Mishra, 2011), marketing efficiency (Modi and Mishra, 2011), and time- vs. cost-based efficiency (Kortmann et al., 2014). As stated earlier, this study focuses on inventory efficiency – construed as a firm's ability to support sales with a minimal amount of inventory (Mishra et al., 2013). This focus is motivated by a desire to contribute to the traditional discussion on the a priori tradeoff between inventory efficiency and customer service as an indicator of operational effectiveness (e.g., Closs et al., 2010).

Inventory efficiency exerts opposing forces on firm profitability due to its divergent impacts on cost containment and revenue generation (Shah and Shin, 2007). Higher levels of efficiency enable firms to reduce inventory-related costs (Modi and Mishra, 2013) but, at the same time, exacerbate their vulnerability to demand and supply uncertainty (Rumyantsev and Netessine, 2007).

Whether a firm benefits from efficiency enhancements or not is a function of the firm's initial position on the efficiency curve. Eroglu and Hofer (2011) show that higher inventory efficiency is not necessarily indicative of superior inventory management. While some firms stand to improve their profitability by cutting inventory (i.e., improving efficiency), others may achieve a similar outcome by doing the exact opposite – i.e., holding more inventory (Eroglu and Hofer, 2011). Typically, firms benefit from efficiency enhancements if their initial position is one reflecting excess inventory (Runyantsev and Netessine, 2007). Such firms can reduce average inventory holdings and associated costs with barely any related negative impact on revenue generation.

Interestingly, most firms tend to hold more inventory than they need to (Chen et al., 2005). The preponderance of behavioral biases such as loss aversion (Tversky and Kahneman, 1986) and the bracing bias (Tokar et al., 2014) provide a rationale for this generalized tendency to overstock. All else equal, inventory managers tend to view shortages as more problematic than overages (Lee and Siemsen, 2016). While a shortage is typically perceived as a pure loss, an overage is often downplayed as a mere inconvenience (Lee and Siemsen, 2016). This imbalanced sensitivity to shortages and overages causes managers to target higher-than-optimal service levels and induces them to hold more inventory than they need to (Lee and Siemsen, 2016). From a bracing bias perspective, inventory managers have been shown to overestimate the likelihood and magnitude of future demand shocks, with inflationary effects on inventory holdings (Tokar et al., 2014). They tend to brace themselves against the overestimated risk of shortage by carrying additional "just-in-case" inventory (Mishra et al., 2013, p. 300).

With such a general bias towards overstocking, I expect efficiency enhancements to yield profitability gains for the typical firm – at least initially. This expectation is all the more plausible that efficiency improvements are often accompanied with or enabled by other systemic enhancements across the organization. For example, Lieberman and Demeester (1999) find that labor productivity improves when work-in-process inventory is reduced. Cachon and Fisher (2000) find the profitability benefits of inventory efficiency enhancements to be compounded by improvements to production scheduling and information sharing.

As stated earlier, however, efficiency improvements are not exclusively beneficial to firm profitability. As much as they reduce inventory-related costs, they also increase the risk of shortage (Kleindorfer and Saad, 2005) with a negative impact on revenue generation and firm profitability (Hendricks and Singhal, 2003). In addition, inventory-related costs typically decline linearly with each unit reduction in average inventory holdings whereas the risk of shortage increases exponentially (Rumyantsev and Netessine, 2007). As such, I expect incremental efficiency improvements to result in positive but declining marginal profitability gains. I therefore posit that:

> **H1**: Inventory efficiency will be positively associated with firm profitability, but at a declining rate.

Effectiveness (Supply Readiness)

Firms are operationally effective to the extent that they provide a source of supply that meets or exceeds customer expectations (e.g., Heikkila, 2002; Hitt et al., 2016; Pagel et al., 2015). Inherently multidimensional, operational effectiveness encompasses indicators such as conformance quality, production flexibility, and fulfillment speed (Rosenzweig and Roth, 2004). In this study, I focus on the latter two indicators as key capabilities underlying a firm's ability to readily meet customer demand – a concept that I henceforth call supply readiness.

Supply readiness confers time-based competitive advantage (Stalk, 1988). It facilitates superior customer value creation through the fast conversion of customer orders into deliveries (Heim et al., 2014). In a business environment where the intrinsic attributes of most product offerings can be replicated relatively easily (Daugherty and Pittman, 1995), supply readiness stands as a meaningful differentiator in the marketplace. All else equal, customers typically favor suppliers with shorter lead-times (Heim et al., 2014). This is partly due to the substantial cost penalties that arise from transacting with less responsive suppliers. Stalk (1988) argues that long lead times require equally long forecast horizons, result in poorer forecast accuracy, exacerbate uncertainty, increase hedging costs (e.g., safety stock requirements), and induce organizational rigidity. As such, suppliers with greater leadtime compression capabilities tend to be in high demand and are often in a position to command premium pricing (Heim et al., 2014; Li and Lee, 1994). Supply readiness is, therefore, a valuable core competency that strengthens firm competitiveness, fosters customer loyalty, enhances market power, and facilitates market share gains (Tu et al., 2006) – with a positive impact on revenue generation and firm profitability.

Supply readiness is, however, costly to develop. To support leadtime compression efforts, firms have to cultivate intra- and inter-organizational production flexibility capabilities commensurate with the level of supply readiness that they aim to achieve (Ketokivi, 2006). Depending on how wide a range of probable demand realizations a firm wants to accommodate, different levels of "investments in excess capacity [including inventory holdings], empty floor space, and slack time in the production schedule" may be needed (Gerwin, 1993, p. 406). Naturally, the more such investments a firm makes, the lower its marginal return due to the exponentially declining probability of extreme demand realizations. As such, I posit that:

> **H2**: Supply readiness will be positively associated with firm profitability, but at a declining rate.

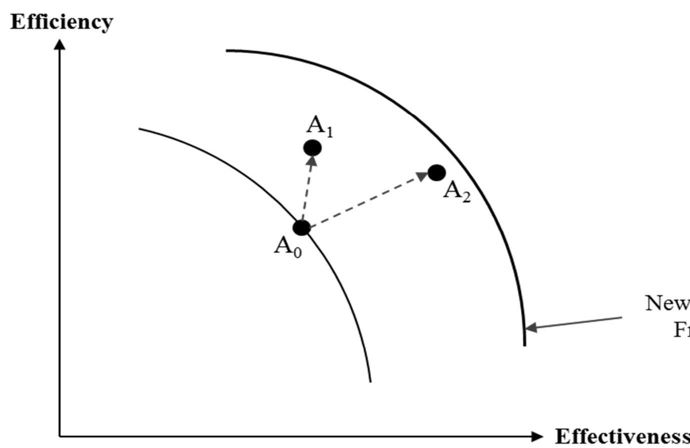
Operational Ambidexterity

While both efficiency and effectiveness have the potential to individually benefit firm profitability, many scholars argue that firms have grown significantly less constrained to pursue excellence in just one or the other (e.g., Blackburn and Scudder, 2009). Various technological advances have made the simultaneous enhancement of efficiency and effectiveness possible, with a compounding effect on the competencies' profit impact (Heim and Peng, 2010).

Mishra et al. (2013) suggest that information technology's (IT) role in facilitating intra- and inter-organizational collaboration has enabled firms to reconcile efficiency and effectiveness in unprecedented ways. Programs such as electronic data interchange (EDI), vendor managed inventory (VMI), radio frequency identification (RFID), and collaborative planning, forecasting, and replenishment (CPFR) are examples of IT-enabled initiatives that facilitate such reconciliation. Advanced manufacturing technologies (AMT) are also credited with enabling the concurrent improvement of efficiency and effectiveness (Blackburn and Scudder, 2009). AMTs have, for example, helped propagate the practice of delayed product differentiation and mass customization. Also referred to as postponement, delayed product differentiation enables firms to enhance both inventory efficiency and supply readiness by using standard components across various product lines at early stages of the production process and leaving final customization till later stages when demand signals are stronger and more reliable (Feitzinger and Lee, 1997).

The principal benefit of these technological advances is not that they eliminate the tradeoff frontier but that they shift it in a way that gives firms an opportunity to design their operations for a wider range of combinations of efficiency and effectiveness (e.g., Adler et al., 1999; Hayes and Pisano, 1996; Rosenzweig and Easton, 2010). Over time, firms gradually internalize and leverage available technologies and best practices in an effort to progress towards the new tradeoff frontier (Cohen and Levinthal, 1990). As they do so, some put greater emphasis on efficiency (e.g., $A_0 \rightarrow A_1$ in Figure 1), while others prioritize effectiveness (e.g., $A_0 \rightarrow A_2$). Although these choices do not preclude the simultaneous improvement of efficiency and effectiveness the way a pure tradeoff scenario would, they reflect second-order tradeoffs – i.e., tradeoffs not between the competencies per se, but between the rates at which each competency is enhanced (Hayes and Pisano, 1996).

Figure 1 – Tradeoff Frontier Shift – Adapted from Hayes and Pisano (1996)



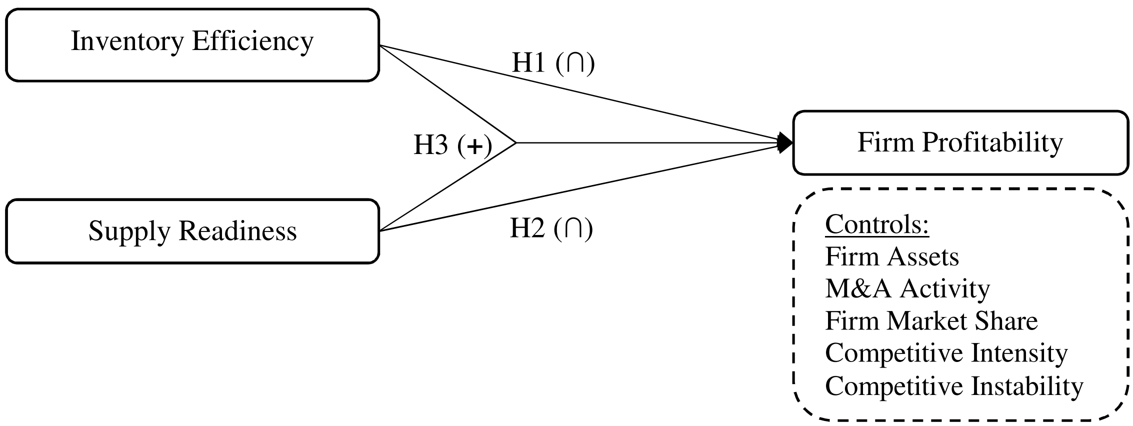
As they internalize available technologies and best practices, I argue that firms that adjust their operations to maximize the combined levels of efficiency and effectiveness, rather than focusing on either in isolation, stand to achieve the greatest profitability gain. Since both competencies are subject to the law of diminishing returns (Schmenner and Swink, 1998) whereby exponentially larger investments are required to marginally enhance each, I argue that the fastest and most profitable trajectory to the tradeoff frontier is likely to be one where efficiency and effectiveness are enhanced concurrently rather than exclusively or sequentially. In other words, I argue that a concurrent one-unit improvement in each competency will be faster to achieve and more profitable than a two-unit improvement in either efficiency or effectiveness in isolation.

Operational Ambidexterity is proposed as a construct that reflects a firm's ability to approach that optimal combination of efficiency and effectiveness through the superior internalization and assimilation of available technologies and best practices. Note that maximal ambidexterity is not necessarily achieved by merely reaching the tradeoff frontier. Maximal ambidexterity is attained by positioning the firm at that unique equilibrium along the tradeoff frontier where a marginal enhancement in efficiency is offset by a resulting deterioration in effectiveness, or vice versa. Such equilibrium indicates that a firm has taken full advantage of the available technologies and best practices such that no further improvement is possible. I propose that the closer a firm gets to that perfect equilibrium, the more profitable it becomes. I, therefore, posit that:

> **H3**: Operational ambidexterity will be positively associated with firm profitability. That is, firm profitability is greater the higher the joint levels of inventory efficiency and supply readiness.

The study's hypotheses are summarized in in Figure 2[1].

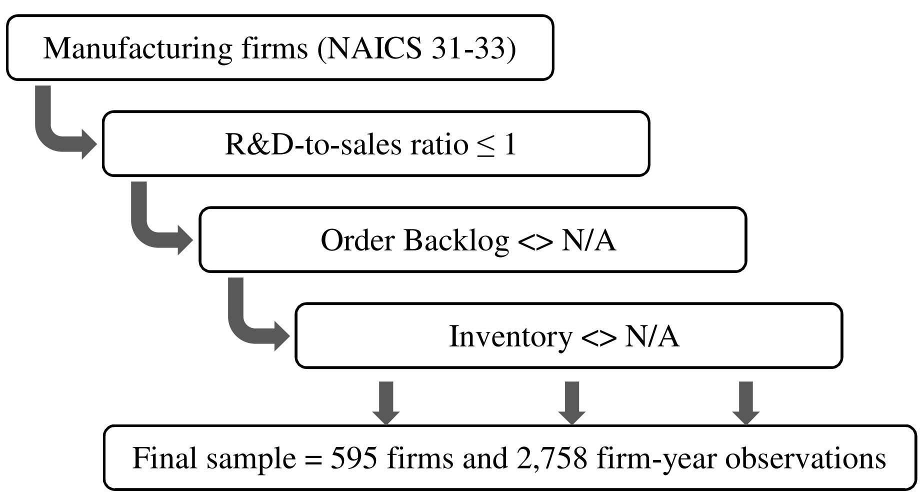
Figure 2 – Conceptual Model



Data and measurement

To test the proposed hypotheses, a large panel dataset was compiled from Standard & Poor's COMPUSTAT database following the procedure outlined in Figure 3.

Figure 3 – Sampling procedure

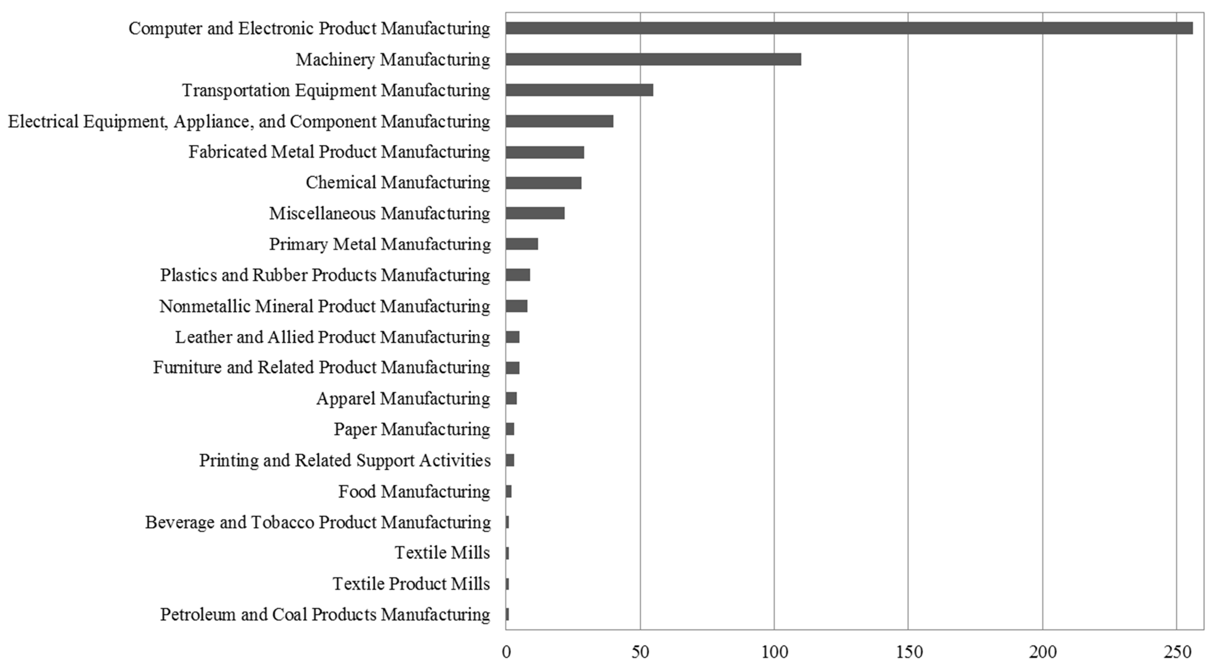


[1] The joint effect corresponds to Operational Ambidexterity as discussed in Hypothesis 3.

The initial sample consisted of all public manufacturing firms (i.e., NAICS codes 31-33) listed in the US between 2010 and 2015. I chose the manufacturing sector for the purpose of continuity with and comparability within the extant research on operations strategy, which happens to focus largely on the manufacturing sector (e.g., Boyer et al., 2005). The sampling period was chosen because it corresponds to the most recent time window that is long-enough for the purpose of this study and void of major exogenous shocks that could otherwise influence the relationships under investigation. I elected to start the sampling period in 2010 to avoid any confounding effects from the 2007-2008 financial crisis. Judging by the US stock market's performance, the US economy started to show the first signs of turnaround in the first semester of 2009, which marked the lowest post-crisis point of the S&P 500 index (Milesi-Ferretti and Tille, 2011). From an initial sample of 3,408 firms and 15,986 firm-year observations, I proceeded to exclude firms that had an R&D-to-sales ratio greater than 1. Firms with such a high R&D intensity ratio tend to have negligible manufacturing operations and are typically viewed as research firms despite being classified as manufacturing firms in the COMPUSTAT database (e.g., Gentry and Shen, 2013). Excluding them from the analysis helps to limit undue effects on the relationships of interest in this study. I also erred on the side of conservatism by excluding observations with missing order backlog data (a key independent variable). An alternative approach could have been to replace missing data with zero values assuming that missing values reflect situations where backlogs are either negligible or indeed zero. This less conservative approach is sometimes used to treat missing R&D expenditure data (e.g., Anderson et al., 2012; Ortiz-Molina, 2006) but was deemed inadequate for this study. After this screening procedure, the final sample consists of an unbalanced panel of 595 firms totaling 2,758 firm-year observations. Figure 4 provides the breakdown of sampled firms by 3-digit NAICS code.

Although the sample spans a wide range of manufacturing industries, it remains dominated by the Computer and Electronic Product Manufacturing and Machinery Manufacturing industries that collectively represent 61% of sampled firms. This skewed distribution is not by design. The skewness is reflective of the underlying population of public manufacturing firms in the COMPUSTAT universe as well as the uneven pervasiveness of backlogs across industries in the manufacturing sector. Order backlogs are most commonly seen in durable goods and computer manufacturing (Rajgopal et al., 2003), hence the relatively strong representation of those industries in the study's sample.

Figure 4 – Number of sampled firms by industry



Dependent variable

Firm Profitability is operationalized using firm gross margin (GM), calculated as follows:

$$\mathrm{GM}_{\mathrm{it}} = \frac{\mathrm{Sales}_{\mathrm{it}} - \mathrm{COGS}_{\mathrm{it}}}{\mathrm{Sales}_{\mathrm{it}}}$$

where $Sales_{it}$ and $COGS_{it}$ correspond respectively to annual revenues and cost of goods sold of firm i in year t.

Gross margin is chosen over alternative measures of profitability commonly used in the literature because it is considered the purest indicator of a firm's ability (or lack thereof) to capture value from operations through the proper leverage of efficiency and effectiveness as conceptualized in this study. Profit metrics that extend beyond gross margin (e.g., operating income, net income, etc.) account for discretionary items such as R&D expenditures and interest expenses that confound the true profit impact of a firm's purely operational choices.

Independent variables

Inventory Efficiency (INVEFF) is measured using the following adaptation of inventory-to-sales ratio were Inv_{it} refers to end-of-year inventory of firm i in year t:

$$\text{INVEFF}_{\text{it}} = 1 - \frac{\text{Inv}_{\text{it}}}{\text{Sales}_{\text{it}}}$$

The adapted measure is chosen over the more commonly used inventory turns metric because it facilitates a more intuitive operationalization of the operational ambidexterity construct (discussed later) conceptualized as the interaction between inventory efficiency and supply readiness. I use (1 – inventory-to-sales) so that higher values of INVEFF reflect higher levels of efficiency. This facilitates the intuitive interpretability of results.

Supply Readiness (READINESS), conceptualized as a firm's ability to readily meet customer demand, is operationalized using an adapted version of Bharadwaj et al.'s (2007) on-time ratio:

$$\text{READINESS}_{\text{it}} = \frac{\text{Sales}_{\text{it}}}{\text{Sales}_{\text{it}} + \text{Backlog}_{\text{it}}}$$

Backlogs are inversely related to a firm's ability to readily meet customer demand as they represent customer orders that are booked but not filled by the end of a fiscal period – e.g., fiscal year (Rajgopal et al., 2003). Large backlogs suggest that an equally large portion of a firm's total demand (i.e., Sales + Backlog) was not filled immediately upon order receipt. As such, larger backlogs are indicative of lower levels of supply readiness.

Operational Ambidexterity (OPAMB) is operationalized as the interaction between inventory efficiency and supply readiness, in line with the commonly used multiplicative operationalization of organizational ambidexterity in the management literature (e.g., Gibson and Birkinshaw, 2004; Cao et al., 2009). Operational Ambidexterity reflects a firm's ability to take advantage of available technologies and operational best practices such that a superior level of combined efficiency (inventory efficiency) and effectiveness (supply readiness) is achieved. OPAMB is operationalized as follows:

$$\mathrm{OPAMB_{it}} = \mathrm{INVEFF_{it}} \text{ x } \mathrm{READINESS_{it}} = \frac{\mathrm{Sales_{it}} - \mathrm{Inv_{it}}}{\mathrm{Sales_{it}} + \mathrm{Backlog_{it}}}$$

The simplified equation above shows that operational ambidexterity is enhanced as long as a reduction in inventory (i.e., higher efficiency) is accompanied by – at worst – a less than proportionate increase in backlogs (i.e., lower readiness), or a reduction in backlogs (i.e., higher readiness) is accompanied by – at worst – a less than proportionate increase in average inventory holdings (i.e., lower efficiency).

Control variables

I control for firm- and industry-level factors known to influence firm profitability. At the firm level, I include a log-transformation of firm total assets ($\mathrm{ASSET_{it}}$) as a means to account for the impact of firm size on firm financial performance (e.g., Eroglu and Hofer, 2011). I also control for mergers and acquisitions by creating a dummy variable ($\mathrm{MNA_{it}}$) coded as 1 if the focal firm engages in M&A activities during fiscal year t, and zero otherwise. Although most acquisitions account for no more than 5% of a firm's total assets (Montgomery and Wilson, 1986), they can at times constitute major transitional events that undermine the temporal comparability of firm accounting data (Rajgopal and Venkatachalam, 2011). Lastly, I control for firm market share ($MKTSHARE_{it}$) for its impact on firm profitability (e.g., Szymanski et al., 1993).

At the industry level, I control for competitive intensity ($COMPINTENSITY_{it}$) which I measure using the Herfindahl-Hirschman Index (HHI) (e.g., Ramaswamy, 2001). Since HHI is often construed as an indicator of industry concentration and competitive structure (e.g., Barnett, 1997), I include an additional rivalry-based control that captures the extent to which individual-firm market shares vary from year to year. This competitive dynamics control ($COMPINSTABILITY_{it}$) is measured using year-over-year absolute change in HHI per 6-digit NAICS code.

Descriptive statistics and pairwise correlations for the entire sample as well as the top two sampled industries (61% of sampled firms) are provided in Table 1.

Table 1 - Descriptive Statistics and Pairwise Correlations

All Sample

Variable	Obs.	Mean	s.d.	Min	Max	1	2	3	4	5	6	7
1 . GM	2758	0.376	0.191	(4.677)	0.939							
2 . INVEFF	2758	0.815	0.122	(0.589)	0.999	0.189*						
3 . READINESS	2758	0.759	0.182	0.035	1.000	0.282*	0.243*					
4 . ASSET (in $bil.)†	2758	3.546	10.494	<0.001	113.481	-0.001	0.208*	-0.152*				
5 . MNA	2758	0.196	0.397	0.000	1.000	-0.004	0.067*	-0.009	0.224*			
6 . MKTSHARE	2758	0.169	0.287	<0.001	1.000	-0.185*	0.122*	-0.074*	0.366*	0.076*		
7 . COMPINTENSITY	2758	3,898	2,531	481	10,000	-0.209*	0.062*	-0.092*	0.034	0.011	0.633*	
8 . COMPINSTABILITY	2758	276	489	0.000	5,889	-0.046*	-0.030	-0.046*	-0.073*	0.000	0.035	0.151*

Operational Ambidexterity is not included since it is operationalized as the interaction of INVEFF and READINESS.

† Correlation coefficients based on log-transformed values of firm total assets for consistency with the empirical analysis.

* Significant at the 0.05 level

Table 1 - Descriptive Statistics and Pairwise Correlations (Cont.)

Computer & Electronic Product Manufacturing

Variable	Obs.	Mean	s.d.	Min	Max	1	2	3	4	5	6	7
1 . GM	1170	0.441	.157	(0.250)	0.939							
2 . INVEFF	1170	0.827	0.105	0.203	0.999	0.200*						
3 . READINESS	1170	0.781	0.161	0.172	1.000	0.267*	0.160*					
4 . ASSET (in $bil.)†	1170	2.863	9.057	0.001	113.481	0.087*	0.374*	-0.077*				
5 . MNA	1170	0.174	0.379	0.000	1.000	-0.036	0.081*	-0.007	0.228*			
6 . MKTSHARE	1170	0.060	0.155	<0.001	1.000	-0.064*	0.172*	-0.062*	0.506*	0.086*		
7 . COMPINTENSITY	1170	3,004	1,976	481	10,000	-0.196*	-0.009	-0.019	-0.054	-0.053	0.324*	
8 . COMPINSTABILITY	1170	259	386	0.000	5,846	-0.008	0.019	0.015	-0.082*	-0.018	0.007	0.371*

Machinery Manufacturing

Variable	Obs.	Mean	s.d.	Min	Max	1	2	3	4	5	6	7
1 . GM	534	0.351	0.148	(1.403)	0.698							
2 . INVEFF	534	0.796	0.121	(0.537)	0.973	0.093*						
3 . READINESS	534	0.746	0.155	0.035	0.975	0.274*	0.217*					
4 . ASSET (in $bil.)†	534	4.044	10.938	0.001	89.356	0.071	0.260*	0.147*				
5 . MNA	534	0.217	0.413	0.000	1.000	0.057	0.102*	0.051	0.209*			
6 . MKTSHARE	534	0.201	0.280	<0.001	1.000	-0.068	0.156*	0.145*	0.368*	0.048		
7 . COMPINTENSITY	534	4,169	2,145	1,690	10,000	-0.042	0.024	-0.062	-0.213*	-0.021	0.548*	
8 . COMPINSTABILITY	534	307	531	0.000	5,889	-0.132*	-0.043	-0.174*	-0.130*	0.029	0.095*	0.255*

Operational Ambidexterity is not included since it is operationalized as the interaction of INVEFF and READINESS.

† Correlation coefficients based on log-transformed values of firm total assets for consistency with the empirical analysis.

* Significant at the 0.05 level

Model specification and estimation

Three hypotheses are proposed in this paper. The first two suggest that the respective effects of inventory efficiency and supply readiness (effectiveness) on firm gross margin will be positive and curvilinear with diminishing returns. One way to test for such effects is to perform a quadratic polynomial regression, and assess whether the linear and quadratic coefficients of inventory efficiency and supply readiness are statistically significant and positive and negative, respectively. The third hypothesis suggests that operational ambidexterity will be positively related to firm gross margin profitability. Support for this third hypothesis is ascertained if the coefficient of the interaction between Inventory Efficiency and Supply Readiness is positive and statistically significant. The following equation provides the mathematical formulation of the model, with X_{it} representing a vector of control variables:

$$\mathrm{GM}_{it} = \mu_i + \beta_1 \mathrm{INVEFF}_{it} + \beta_2 \mathrm{READINESS}_{it} + \beta_3 \mathrm{INVEFF}_{it}{}^2 + \beta_4 \mathrm{READINESS}_{it}{}^2 + \beta_5 \mathrm{OPAMB}_{it} + \delta X_{it} + \varepsilon_{it}$$

Given the panel structure of the dataset used in this study, determining the appropriate estimation procedure require that I first test for the presence of panel effects. To that end, I ran the Breusch-Pagan Lagrange Multiplier (BPLM) test, which assesses the null hypothesis that the variance across units (firms in this case) is zero. With a χ^2 statistic equal to 2,137 (p-value<0.0001), the BPLM test rejected the null – thus confirming the presence of panel effects and indicating that a simple OLS regression may not be appropriate due to a lack of independence among observations. I also ran a Wooldridge Lagrange Multiplier test for panel autocorrelation, but no evidence for serial correlation of residuals was found (F-statistic =2.702; p-value=0.101).

Besides panel effects and serial correlation, I also recognize the risk of omitted variable bias. Many unmeasured phenomena can influence the outcome of interest (firm profitability) beyond the independent variables included in the model. Failing to account for such phenomena can cause coefficient estimates to be biased. To mitigate that risk, I use fixed-effects modeling, which mean-centers the original data within each panel (firm in this case) then runs an ordinary-least-squares estimation on the transformed dataset. This fixed effects procedure accounts for time-constant, unobserved heterogeneity across panels and significantly reduces the risk of omitted variable bias (Kennedy, 2003). Fixed effects models are also appropriate, unlike random-effects models, when the researcher is interested in estimating within-panel, short-run relationships (Kennedy, 2003) – as is the case in this study. I am particularly interested in understanding how a typical firm's profitability evolves as a function of efficiency, effectiveness, and operational ambidexterity year over year – which corresponds to within (as opposed to between) variance.

Results

Table 2 provides the study's empirical results at different levels of granularity. Panels A show aggregate, sector-level results for the entire sample. Panels B and C provide more granular, industry-level results for the two most represented industries in the sample: Computer and Electronic Product Manufacturing and Machinery Manufacturing, respectively. All results are discussed next, one hypothesis at a time.

Table 2 - Estimation Results; DV = Firm Gross Margin

Variables	All Sample					
	A1		*A2*		*A3*	
INVEFF	0.388	***	0.493	***	-0.013	
	(0.034)		*(0.060)*		*(0.077)*	
READINESS	-0.045		0.264	*	-0.142	
	(0.035)		*(0.144)*		*(0.146)*	
INVEFF^2			-0.125	**	-0.247	***
			(0.053)		*(0.053)*	
READINESS^2			-0.232	**	-0.520	***
			(0.108)		*(0.109)*	
OPAMB					1.036	***
					(0.102)	
ASSET	0.040	***	0.040	***	0.035	***
	(0.007)		*(0.007)*		*(0.007)*	
MNA	0.001		0.000		0.001	
	(0.005)		*(0.005)*		*(0.005)*	
MKTSHARE	-0.015		-0.016		-0.013	
	(0.037)		*(0.037)*		*(0.036)*	
COMPINTENSITY †	0.017		0.013		0.023	
	(0.032)		*(0.032)*		*(0.032)*	
COMPINSTABILITY †	-0.034		-0.031		-0.023	
	(0.042)		*(0.042)*		*(0.041)*	
Intercept	-0.154	**	-0.249	***	0.110	
	(0.060)		*(0.071)*		*(0.078)*	
R^2	0.06		0.07		0.11	
F-statistic	20.87	***	17.54	***	26.91	***
# of Observations	2758		2758		2758	
# of Firms	595		595		595	

Standard errors between parentheses; *p < 0.1; **p < 0.05; ***p < 0.01

† Coefficient estimates multiplied by 10,000 to facilitate readability.

Table 2 - Estimation Results; DV = Firm Gross Margin (Cont.)

Variables	Computer & Electronic Product Mfg					
	B1		*B2*		*B3*	
INVEFF	0.206	***	0.178		0.187	
	(0.028)		*(0.123)*		*(0.124)*	
READINESS	-0.100	***	-0.012		0.012	
	(0.024)		*(0.106)*		*(0.113)*	
INVEFF^2			0.018		0.044	
			(0.089)		*(0.099)*	
READINESS^2			-0.065		-0.045	
			(0.076)		*(0.083)*	
OPAMB					-0.067	
					(0.111)	
ASSET	0.029	***	0.029	***	0.029	***
	(0.005)		*(0.005)*		*(0.005)*	
MNA	-0.002		-0.002		-0.002	
	(0.004)		*(0.004)*		*(0.004)*	
MKTSHARE	-0.095		-0.094		-0.094	
	(0.067)		*(0.067)*		*(0.067)*	
COMPINTENSITY †	0.029		0.029		0.028	
	(0.028)		*(0.021)*		*(0.021)*	
COMPINSTABILITY †	0.032		0.030		0.031	
	(0.037)		*(0.037)*		*(0.037)*	
Intercept	0.177	***	0.160	***	0.147	**
	(0.042)		*(0.060)*		*(0.064)*	
R^2	0.08		0.08		0.08	
F-statistic	11.36	***	8.90	***	8.04	***
# of Observations	1170		1170		1170	
# of Firms	256		256		256	

Standard errors between parentheses; *p < 0.1; **p < 0.05; ***p < 0.01

† Coefficient estimates multiplied by 10,000 to facilitate readability.

Table 2 - Estimation Results; DV = Firm Gross Margin (Cont.)

Variables	Machinery Mfg					
	C1		*C2*		*C3*	
INVEFF	0.241	***	-0.219	***	-0.271	***
	(0.046)		*(0.066)*		*(0.067)*	
READINESS	0.067		1.837	***	1.659	***
	(0.056)		*(0.218)*		*(0.222)*	
INVEFF^2			0.381	***	-0.024	
			(0.060)		*(0.134)*	
READINESS^2			-1.310	***	-1.634	***
			(0.154)		*(0.180)*	
OPAMB					0.890	***
					(0.264)	
ASSET	0.033	***	0.038	***	0.032	***
	(0.012)		*(0.011)*		*(0.011)*	
MNA	-0.001		0.000		0.001	
	(0.008)		*(0.007)*		*(0.007)*	
MKTSHARE	-0.032		-0.587		-0.060	
	(0.065)		*(0.058)*		*(0.057)*	
COMPINTENSITY †	-0.040		-0.036		-0.028	
	(0.053)		*(0.048)*		*(0.048)*	
COMPINSTABILITY †	-0.086		-0.101		-0.097	
	(0.094)		*(0.050)*		*(0.049)*	
Intercept	-0.077		-0.549	***	-0.423	***
	(0.094)		*(0.102)*		*(0.107)*	
R^2	0.10		0.28		0.29	
F-statistic	6.43	***	17.51	***	17.29	***
# of Observations	534		534		534	
# of Firms	110		110		110	

Standard errors between parentheses; *p < 0.1; **p < 0.05; ***p < 0.01
† Coefficient estimates multiplied by 10,000 to facilitate readability.

Table 3 - Summary of hypothesis-testing results

Hypothesis	Testing Variable (expectation)	All Sample	Computer & Electronic Product Mfg	Machinery Mfg
1	Inv. Efficiency (∩)	Supported	Partially Supported	Partially Supported
2	Supp. Readiness (∩)	Supported	n.s	Supported
3	Op. Ambidexterity (+)	Supported	n.s	Supported

Hypothesis 1: Inventory Efficiency and Gross Margin Profitability

Hypothesis 1 proposed that inventory efficiency would have a positive effect on firm profitability but with diminishing returns. Results from panels A1 and A2 provide support for the hypothesized relationship at the sector level. The coefficient estimate of inventory efficiency is positive and statistically significant ($\beta 1=0.388$; p-value<0.001), and that of the associated quadratic term is significantly negative ($\beta 3=-0.125$; p-value=0.019). Results at the industry-level are slightly more nuanced. For the computer and electronic product manufacturing industry, results show that the effect of efficiency on firm gross margin profitability is indeed positive ($\beta 1=0.206$; p-value<0.001). However, no evidence for a curvilinear relationship is found ($\beta 3=0.018$; p-value=0.838). Inventory efficiency appears to have a strictly linear effect on firm profitability, thus providing partial support for H1. In the machinery manufacturing industry, panels C1 and C2 show inventory efficiency to have a positive and strengthening effect on gross margin profitability as evidenced by the coefficients of the linear ($\beta 1=0.241$; p-value<0.001) and quadratic inventory efficiency terms ($\beta 3=0.381$; p-value<0.001). This goes partially counter to the hypothesized relationship, which proposed a positive but declining profit impact. H1 is, therefore, only partially supported for the machinery manufacturing industry.

Hypothesis 2: Supply Readiness and Gross Margin Profitability

Hypothesis 2 proposed that supply readiness (an indicator of operational effectiveness) would have a positive curvilinear effect with diminishing returns on firm profitability. Results from panels A1 and A2 provide support for the hypothesized relationship at the sector level as evidenced by the positive and negative coefficient estimates of supply readiness for the linear ($\beta_2=0.264$; p-value=0.067) and quadratic ($\beta_4=-0.232$; p-value=0.032) terms, respectively. The hypothesis is, however, not supported for the computer and electronic product manufacturing industry (cf. panel B1). Manufacturers in this industry tend to have strictly negative returns to improvements in supply readiness (β_2=-0.1; p-value<0.001). This is somewhat surprising given the industry's fast-paced, hyper-competitive environment where one would expect rapid customer order fulfillment to provide a significant competitive edge. At the same time, one could speculatively rationalize the surprising finding based on the possible cost penalty of having obsolescence-prone slack capacity. Lastly, the hypothesis is supported for the machinery manufacturing industry judging by the coefficient estimates of the linear (β_2=1.837; p-value<0.001) and quadratic (β_4=-1.31; p-value<0.001) terms of supply readiness.

Hypothesis 3: Operational Ambidexterity and Gross Margin Profitability

Hypothesis 3 suggested that operational ambidexterity (i.e., a firm's ability to enhance both inventory efficiency and supply readiness concurrently) would have a positive effect on firm profitability. Empirical results show the hypothesized relationship to be supported at the sector level, as evidenced by a positive and statistically significant coefficient estimate of operational ambidexterity in panel A3 (β_5=1.036; p-value<0.001). This sample-wide result is, however, not confirmed for the computer and electronic product manufacturing industry (β_5=-0.067; p-value=0.546). While the finding fails to provide support for the cumulative perspective in this specific industry, it does not offer support for the tradeoff perspective either. It shows, together with results from panel B1, that computer and electronic product manufacturers tend to be penalized for enhancing supply readiness – whether that is undertaken in isolation or in conjunction with concomitant improvements to inventory efficiency. In contrast, machinery manufacturers are shown to significantly benefit from the simultaneous improvement of efficiency and effectiveness, in line with results from the manufacturing sector at large (β_5=0.890; p-value=0.001). All in all, the empirical results show that manufacturing firms can, to a large extent, successfully reconcile efficiency and effectiveness (r=0.243; p-value<0.001) with a positive compounded impact on firm gross margin profitability. Table 3 provides a summary of all hypothesis-testing results.

Discussion and conclusion

This research explored the inner dynamics of operational excellence by investigating the individual and collective effects of operational efficiency and operational effectiveness on firm profitability. In so doing, it assessed the respective merits of two major perspectives in operations strategy: the tradeoff and cumulative perspectives. Whereas the former views efficiency and effectiveness as mutually exclusive and, thus, difficult to enhance simultaneously (Skinner, 1969); the latter considers the two competencies to be mutually supportive and amenable to concurrent improvements – implying that the tradeoff perspective may be premised on a false dichotomy (Ferdows and De Meyer, 1990; Blackburn and Scudder, 2009).

The study's main thrust was to determine which of the two perspectives held a higher promise. To that end, I drew on Porter's (1980) profit maximization prescription suggesting that the pertinence of a firm's operations strategy is not determined by whether the strategy facilitates excellence in efficiency, effectiveness, or both; but by the extent to which the operational achievements that it facilitates translate into firm profitability. Within this profit maximization framework, the tradeoff perspective would be superior if efficiency and effectiveness had an uncapped profit potential individually, but a negative profit impact collectively. The cumulative perspective, on the other hand, would be superior if concurrent enhancements of efficiency and effectiveness (i.e., operational ambidexterity) had a positive impact on firm profitability.

Because of the relative dominance of two industries in the sample, empirical analyses were conducted at two levels of granularity: at the sector level (i.e., across the entire manufacturing sector, as sampled) and at the industry level for the dominating industries – computer and electronic product manufacturing and machinery manufacturing.

At the sector level, empirical results clearly indicated the superiority of the cumulative perspective. The individual effects of efficiency and effectiveness on firm profitability were found to be positive and curvilinear with diminishing returns. In other words, individual enhancements to either competency in isolation tended to improve firm profitability only up to a point. Beyond that point further improvements resulted in negative marginal returns. For example, the marginal profitability benefit of supply readiness (a key indicator of effectiveness) was found to be positive up to a score of 0.571 (for a sample range of 0.035 to 1) and increasingly negative beyond that point. As per the profit impact of concurrent enhancements in efficiency and effectiveness, empirical results provided evidence for a synergistic effect of operational ambidexterity, thus lending support to the cumulative perspective over the tradeoff model.

At the industry level, results were noticeably more nuanced. Evidence from the computer and electronic product manufacturing industry showed no support for either the tradeoff model or the cumulative perspective, as operational ambidexterity had no significant impact on firm profitability. Individually, however, inventory efficiency had a strictly linear positive effect on profitability while supply readiness had a strictly negative impact. As mentioned earlier, this result was surprising but not implausible. The computer and electronic product manufacturing industry is notorious for its rapid technological progress and inordinate risk of obsolescence. In such an environment, a lack of efficiency is likely to translate into frequent and substantial write-offs with material negative effects on firm profitability. Heavy investments in infrastructure that enables supply readiness may also put a heavy burden on firm profitability with no guarantee that the infrastructure remains relevant long enough for there to be a satisfactory return on investment. For example, when technologically more advanced offerings from the competition caused Sony's sales in the personal computer market to fall short of projections in 2013, the company had to write inventory down by more than $300 million with a substantial negative impact on profitability (Tabuchi, 2014). The company had to also revamp its supply readiness infrastructure to better synchronize its operations with changing market dynamics, with an even greater loss in profitability. Form an initial projection of an annual profit of $500 million, the company revised its outlook to a loss of $1.3 billion (Tabuchi, 2014).

Empirical results from the machinery manufacturing industry, on the other hand, provided support for the cumulative perspective, in line with sector-level findings. Operational ambidexterity was found to offer synergistic benefits as indicated by the compounded positive impact of concurrent improvements in inventory efficiency and supply readiness on firm profitability.

The present study contributes to the operations strategy literature in several ways. First, it reinforces the cumulative perspective's proposition that firms can indeed profitably enhance efficiency and effectiveness simultaneously. This is of particular significance given that most firms still design their operations for focused excellence in either efficiency or effectiveness on the premise that "few unfocused factories outperform competitors" (Brumme et al., 2015, p. 1513). At the same time, the study shows that all industries do not benefit from operational ambidexterity in the same fashion, if at all. For example, firm profitability in the computer and electronic product manufacturing industry is not impacted by operational ambidexterity, neither positively nor negatively. This nuanced finding – relative to the strong support for ambidexterity as an enabler of firm profitability at the sector level – seems to indicate that industry-level factors such as competitive dynamics and average product lifecycle may act as salient contingencies affecting the differential pertinence of the tradeoff and cumulative perspectives, respectively. Future research may explore this possibility at a more granular level.

Second, the study goes beyond the traditional question of feasibility addressed by most of the relevant literature; it provides a performance-based assessment of operational ambidexterity. Prior research had mostly been concerned with the face validity of ambidexterity as an evolutionary practice from the more traditional tradeoff approach, with only minimal attention given to the practice's profit impact. While that provides valuable insights and helps to evaluate the appeal and potential adoption of the cumulative perspective, it may not be effective in establishing the perspective's pertinence – at least not as much as providing evidence for a significant profit impact would.

Third, it answers Rosenzweig and Easton's (2010) call for a longitudinal perspective to the study of tradeoffs (or lack thereof) in operations strategy. It also answers the same authors' call for research that uses objective measures of efficiency and effectiveness as an alternative to the more commonly used self-report, perception-based approach.

From a managerial perspective, the evidence provided for a positive impact of operational ambidexterity on firm profitability has the potential to shift mindsets and encourage a more encompassing approach to strategy formulation in operations management. The study's findings, in conjunction with prior research highlighting the conceptual appeal of the cumulative perspective, are likely to spur more initiatives aimed at reconciling efficiency and effectiveness for enhanced firm profitability. In addition to the strategy formulation implications, the proposed measurement for operational ambidexterity provides a simple and easy-to-use metric that can facilitate strategic control. Managers can use the metric to compare their firm's ability to reconcile efficiency and effectiveness with industry benchmarks as well as against the firm's own historical realizations.

Besides the abovementioned contributions, this study has a few limitations that could be alleviated in future research. First, by using a backlog-based operationalization of supply readiness, the study de facto overlooks manufacturing industries where backlogs are not common practice. This limitation reduces the generalizability of findings to industries beyond the ones considered in the study. Future research may consider alternate measures of supply readiness that would enable a more comprehensive sampling for stronger external validity. Second, the research addresses the tradeoff and cumulative perspectives based on inventory efficiency and supply readiness as key indicators of operational efficiency and operational effectiveness. As discussed, there are other indicators of efficiency and effectiveness such as conformance quality and production efficiency that the study does not investigate. Future research may look into tradeoffs among other indicators to augment the findings of this study and further enhance our understanding of the merits of operations strategy's tradeoff and cumulative perspectives respectively.

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III. Essay 2 – Operational excellence and long-term value creation: A stock market perspective on the productivity dilemma

Abstract

Operational excellence is sometimes viewed as inherently incompatible with long-term value creation. The productivity dilemma literature, in particular, views operational excellence unfavorably; firms with a pronounced emphasis on operational excellence are said to be too short-term oriented and at risk of trading long-term viability for short-term profitability. Empirical evidence from the operations and finance literatures, however, suggests that operational excellence may facilitate internal cash-flow generation – which, in turn, is an effective financing instrument for firm growth and long-term value creation. In light of these contrasting views and findings, this research revisits the relationship between operational excellence and long-term value creation. Adopting a stock market perspective and drawing on signaling theory, I argue that stock market participants will view operational excellence as a positive signal for value creation in the long term. In light of propositions from the productivity dilemma literature, I hypothesize that this effect is contingent on two factors: the stock market's expectation of firm short-term revenue growth and the firm's research and development efforts. Short-term revenue growth expectations are suggested to have a dampening effect on the stock market's anticipation of long-term value, whereas firm R&D efforts are expected to strengthen the market's positive outlook. The empirical analysis is based on a panel data set of 864 publicly traded US manufacturing firms over the 2010-2015 period, and the results provide support for the hypothesized relationships. Implications for research and practice are discussed.

Introduction

Process management practices such as Just-In-Time and Total Quality Management are usually leveraged to streamline day-to-day operations for consistency and process reliability (Ding, 2015). When properly implemented, they facilitate the achievement of operational excellence (Kaplan and Norton, 2008) – i.e., a core competency reflecting a firm's ability to efficiently, effectively, and profitably run its day-to-day operations (Treacy and Wiersema, 1993). Operational excellence is in that sense a short-term performance benefit of properly implemented process management practices and a potent enabler of firm competitive advantage (Kaplan and Norton, 2008; Treacy and Wiersema, 1993).

It has been suggested, however, that the benefits of process management practices can be ephemeral and at odds with strategic flexibility and long-term value creation (Adler et al., 2009). The productivity dilemma literature, in particular, suggests that firms with a pronounced emphasis on process management are at risk of growing too entrenched in a narrowly defined modus operandi and, thus, become vulnerable to changing market conditions (Benner and Tushman, 2003). Proponents of this line of thought portray process management practices as a double-edged sword with opposing short- and long-term effects on firm performance. As much as they praise the practices for enabling the "consistent execution" (Adler et al., 2009, p.99) of firm strategy in the short term, they warn that the practices "can also hinder learning and innovation, leaving organizations rigid and inflexible" in the long term (Adler et al., 2009, p.99). In a sense, the productivity dilemma literature suggests that there is a tradeoff between short-term operational excellence and long-term value creation (Adler et al., 2009; Benner and Tushman, 2003).

Although compelling in many ways, the productivity dilemma argument stands in stark contrast with abounding anecdotal evidence of organizations successfully leveraging process management practices to propel themselves to the forefront of their respective industries. Companies such as Toyota and Walmart explicitly attribute most of their long-standing success to their ability to achieve operational excellence through the proper implementation of superior process management practices. Toyota's continuous-improvement philosophy has earned the company the title of world's greatest manufacturer many times over (Liker and Franz, 2011), and Walmart's superior logistics and process management practices have enabled the company to dominate the retail industry for decades (Miller, 2014). Indeed, in an interview with CNBC, Walmart CEO Doug McMillon said that process-management-driven operational excellence spurs productivity in the short term and provides necessary cash to finance expansion plans and enable long-term shareholder value creation (CNBC, 2015).

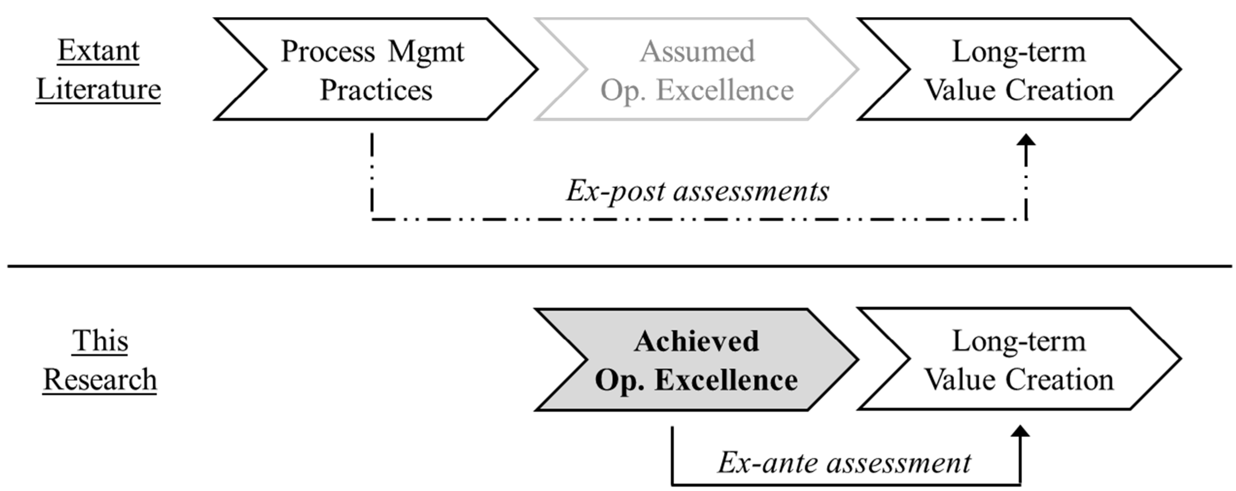
In line with these anecdotal observations, empirical evidence from the finance and operations management literatures appears to collectively indicate that the proper implementation of process management practices may, in fact, facilitate rather than obstruct firm growth and long-term value creation. Research in operations management has linked process management practices to firm cash-flow generation (Fullerton et al., 2003), and the finance literature has shown internal cash-flow generation to serve as the primary financing instrument for firm expansion plans and long-term growth (Myers, 1984; Strebulaev and Yang, 2013). All in all, these anecdotal and empirical observations invite the conjecture that properly implemented process management practices may be an effective instrument for firm long-term value creation (LTVC).

This research assesses the validity of that conjecture by investigating the extent to which a firm's successful implementation of process management practices, as reflected in the firm's achieved operational excellence, signals long-term value creation as anticipated by the stock market. Value is herein construed from the shareholder's perspective in accordance with the view that shareholder value maximization is the most encompassing indicator of long-term value creation (Sundaram and Inkpen, 2004); maximizing shareholder value is said to "implicitly provide a mechanism to reach a proper balance between the conflicting objectives of the various stakeholders of a firm" (Klibi et al., 2010, p.286). Firm market value is, therefore, used as an indicator of long-term shareholder value creation (e.g., Lavie et al., 2011).

Drawing on signaling theory (Spence, 1973), I argue that the investment community will – contrary to the productivity dilemma narrative – view operational excellence as a positive signal for long-term shareholder value creation. This positive assessment is, however, hypothesized to be contextual and contingent on two market- and firm-level factors: (1) the stock market's expectation of firm short-term revenue growth and (2) the firm's R&D efforts. Firm short-term revenue growth expectations are suggested to have a dampening effect on the stock market's assessment of the long-term value creation potential of operational excellence, whereas firm R&D efforts are hypothesized to strengthen the stock market's positive outlook.

This research departs from and augments the extant literature in two major ways (cf. Figure 1). First, it focuses on achieved operational excellence as the antecedent of interest driving long-term value creation. Most of the existing literature links process management practices such as Total Quality Management (e.g., Powell, 1995), Just-In-Time (e.g., Fullerton et al., 2003), and Six Sigma (e.g., Shafer and Moeller, 2012) to long-term value creation without controlling for the effectiveness with which such practices are implemented. While those studies contribute valuable insights and advance our understanding of the strategic value of process management, they leave room for implementation-related confounds. Two firms implementing the same process management practices may not necessarily achieve the same level of operational excellence due to possible differences in implementation effectiveness. Studies that do not account for such differences de facto assume that process management practices invariably and uniformly lead to operational excellence across firms and contexts irrespective of how effectively (or not) the practices are implemented. By measuring achieved operational excellence (instead of assuming it) and using it as the antecedent of interest, this research effectively eliminates the risk of implementation-related confounds and isolates the effect of properly implemented process management practices on the stock market's assessment of LTVC.

Figure 1 – Extant literature vs. this research



The second way this research departs from and augments the extant literature is by relying on the stock market's ex-ante assessment of long-term value creation. This is again motivated by a concern about confounding effects. Previous studies have mostly measured long-term value creation using ex-post assessments (Hendricks and Singhal, 2001a; Modi and Mishra, 2011; Benner and Tushman, 2002). The most common ex-post assessment consists in measuring performance outcomes three to five years after some process management practices are implemented (e.g., Powell, 1995; Douglas and Judge, 2001; Shah and Ward, 2003). While these assessments can be practically appealing, the substantial temporal separation between the trigger event (e.g., implementation of process management practices) and the presumed long-term outcome (e.g., value creation) makes it difficult to unambiguously establish causality. A multitude of events, both exogenous and endogenous (e.g., new competitive landscape, change of management), could occur at any time during the three to five year window separating the observation of the trigger and the measurement of the outcome. Such unaccounted-for events could have material effects on the presumed outcome, thus confounding the relationship of interest. To work around this risk of confounding events, I use the stock market's ex-ante assessment of firm future cash flows into infinity as a means to measure anticipated LTVC (e.g., Hillman and Keim, 2001). This approach, premised on the efficient markets hypothesis that views markets as collectively efficient and effective in evaluating the cash-flow generation potential of public firms (Fama, 1998), has been shown to reasonably approximate ex-post realizations (e.g., Kale et al., 2012).

This research contributes to theory and practice in several ways. First, it advances our understanding of the strategic value of properly implemented process management practices by examining the LTVC potential of operational excellence. Second, it helps top managers reduce the risk of suboptimal strategy formulation by providing boundary conditions to the long-term benefits of operational excellence in the form of two contingency factors – firm short-term revenue growth prospects and firm R&D efforts. Third, it provides a rationale as to why many top executives continue to aggressively pursue process management and associated operational excellence despite numerous warnings from the productivity dilemma literature.

Background and hypotheses

Despite a strong indictment from the conceptual productivity dilemma literature, empirical research addressing the long-term value creation potential of process management practices and associated operational excellence remains surprisingly sparse. While numerous studies have addressed and documented the practices' various short-term benefits (e.g., Anand et al., 2010; Tatikonda et al., 2013), few have examined the corresponding long-term effects – achieved, perceived, or anticipated. With a relative emphasis on the impact of practices such as Total Quality Management (TQM) and Just-In-Time (JIT), empirical findings are relatively dated and remain collectively inconclusive. Using self-reported perceptual measures of firm performance, Powell (1995) and Samson and Terziovski (1999) found no evidence that TQM helps create value three years post implementation. In contrast, Douglas and Judge (2001) found evidence of a strong positive relationship over the same timeframe using the same perceptual measures. Similar conflicting findings are also reported by studies using objective measures of LTVC. Whereas Easton and Jarrell (1998) claim strong positive value-creation effects three to five years post implementation, Staw and Epstein (2000) find no such evidence.

A potential reason for the inconsistent results in prior research could be that the performance benefits of process management practice were studied without ascertaining implementation effectiveness (York and Miree, 2004). To remedy this possible weakness, Hendricks and Singhal (2001b) focused on firms that have been recognized – through quality awards – for their effective implementation of process management practices. Investigating long-term market-based performance outcomes, Hendricks and Singhal (2001b) show award winners to significantly outperform non-winners on the stock market up to five years post recognition. However, York and Miree (2004) expressed concern over the adequacy of using quality awards as a proxy for implementation effectiveness, arguing that different quality awards have different "criteria, standards, and levels of competition" (p. 294) and may not be consistent means of ascertaining implementation effectiveness.

In light of the literature's conflicting findings and the concern raised by York and Miree (2004), this research revisits the relationship between properly implemented process management practices and long-term value creation. Achieved operational excellence is used as an objective indicator of proper implementation and is linked to LTVC as anticipated by the stock market. By focusing on achieved operational excellence as the antecedent of interest, this research aims to establish a confound-free link between the proper implementation of process management practices and LTVC.

Drawing on signaling theory (Spence, 1973), this research is premised on the idea that operational excellence information embedded in a firm's financial statements and accompanying notes will act as an objective signal that the investment community can use to make inferences about the firm's LTVC prospects. Despite their focus on past realizations, financial statements are widely referred to by market participants as signal-carrying media from which insights into the strategic orientation and LTVC potential of corporations can be gleaned (Ou and Penman, 1989). It is expected that the stock market will, in accordance with the efficient markets hypothesis[2], adjust its assessment of firm LTVC prospects as new operational excellence signals become available.

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[2] The efficient market hypothesis stipulates that stock market participants are collectively efficient at gathering, sorting, interpreting, and assimilating large amounts of investment-value

Signaling theory

Introduced by Michael Spence (1973), signaling theory suggests that markets are often characterized by incomplete and asymmetrically located information. In most transactions, one party – the insider – may privately hold pertinent information without which the other party – the outsider – may inadequately assess the underlying value of the object of the transaction (Connelly et al., 2011). Two types of information are of particular interest in this case: information about quality and information about intent (Stiglitz, 2000). The first pertains to characteristics of the object of the transaction whereas the second relates to the behavior and behavioral intentions of the insider (Connelly et al., 2011). An outsider that lacks full knowledge of either quality or intent is expected to seek observable and alterable characteristics that reasonably qualify the object of the transaction and give an indication of the insider's intent (Bergh and Gibbons, 2010; Certo, 2003). Such characteristics are called signals (Spence, 2002) and are meant to reduce the outsider's informational disadvantage and increase the accuracy of his/her assessment of the transaction at hand.

According to signaling theory (Spence, 1973), signals have to meet two conditions to be effective. First, they must be sufficiently costly to the signaler (Bergh and Gibbons, 2010) such that they can neither be obtained without merit nor be fabricated without a prohibitively high opportunity cost to the signaler (Connelly et al., 2011). Second, they must be deemed by the receiver – i.e., the outsider – as having high information value about quality and intent (Bergh and Gibbons, 2010). The information content of financial statements meets both conditions. First, the format, content, and reporting requirements of financial statements are regulated by the Financial Accounting Standards Board (FASB) and strictly monitored by the Securities and

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information (Womack, 1996) to effectively assess the long-term value creation potential of public equities (Fama, 1998).

Exchange Commission (SEC) with the clear purpose to make reported financial information as reflective of the true financial health and performance of corporations as possible (Beaver et al., 2005). The institution of internal audit committees and the requirement that financial statements of public corporations be reviewed and validated by independent external auditors are just two measures, among many, that make signaling through financial statements costly to corporate managers and difficult to fabricate (Xie et al., 2003). Second, financial statements are widely perceived by market participants as a valuable source of information on the underlying quality and value creation potential of public corporations (Ou and Penman, 1989; Frankel and Li, 2004).

Operational excellence and long-term value creation

Operational excellence signals a firm's ability to efficiently, effectively, and profitably[3] fulfill its competitive strategy (Adam and Samidass, 1989; Treacy and Wiersema, 1993). A short-term performance outcome of the proper implementation of process management practices (Treacy and Wiersema, 1993), operational excellence is often viewed as a strong indicator of superior executional capabilities (Kaplan and Norton, 2008).

The ability to properly execute firm strategy is as a major source of competitive advantage (Kaplan and Norton, 2008) and a substantial facilitator of shareholder value creation. Porter (1979) observes that superior executional capabilities enable above-average returns and create superior shareholder value. Knott (2003) offers empirical evidence corroborating Porter's

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[3] Efficiency refers to a firm's ability to generate more output per unit of input or use less input per unit of output, relative to peers; the greater the output to input ratio, the more efficient the firm is (Priem and Butler, 2001). Effectiveness reflects the ability of a firm to use scarce resources to fulfill its market promise (Heikkila, 2002). On-time delivery and order fulfillment accuracy are examples of indicators of operational effectiveness. Operating profitability indicates a firm's ability to capture value from sales proceeds after accounting for the cost of operating inputs and transformational resources (Bowman and Ambrosini, 2000).

observation; she shows that franchised establishments – known for their routinized processes and superior executional capabilities – generate 50% higher total returns than independently run peers (Knott, 2003).

Operational excellence is also positively associated with revenue generation (Reed et al., 1996). Firms with proven records of operational excellence signal dependability and invite stronger business ties with potential partners (Shin et al., 2000). In an environment where supply chain disruptions can be extremely costly (Hendricks and Singhal, 2003), firms with a proven ability to provide a reliable source of supply are in high demand (Wang et al., 2010). Such firms reduce client exposure to supply uncertainty and offer transaction-cost advantages over the competition (Williamson, 1981). As such, they are likely to enjoy stronger and longer-lasting business ties that are conducive to more stable and sustainable revenue streams (Kalwani and Narayandas, 1995). Operational excellence is, therefore, expected to be viewed as a signal for LTVC through enhanced revenue generation.

The positive impact on revenue generation, coupled with a well-documented effect on cost containment and waste elimination (e.g., Browning and Heath, 2009), makes operational excellence an effective free-cash-flow generation instrument and an ideal enabler of firm growth and LTVC. Short-term cash flow generation has been identified as the most effective facilitator of long-term expansion plans. Myers' (1984) seminal study on the capital structure of corporations found that 62% of all capital expenditures of non-financial US corporations from 1973 to 1982 were financed with internally generated cash. The study's finding – more recently confirmed in a study over the period 1962-2009 (Strebulaev and Yang, 2013) – implies that operational excellence can be a potent enabler of LTVC through short-term cash-flow generation.

Lastly, operational excellence is a versatile competency that can be leveraged to initiate forays into new markets (Markman et al., 2009). Many routinized processes lend themselves to be implemented across markets and industries, enabling companies to achieve economies of scope and LTVC (Wernerfelt, 1984). For example, Amazon's operational excellence has enabled the company to break down industry barriers in unprecedented ways. Starting as an online bookstore, the company leveraged the versatility of its operational routines and processes to expand into an extensive list of new product categories and create above-average long-term shareholder value as a result.

H1: Achieved operational excellence will be positively associated with anticipated long-term value creation.

The moderating effect of short-term revenue growth expectations

A central element in the productivity dilemma literature is its focus on growth opportunities as the upside potential at risk of being sacrificed in the pursuit of operational excellence (Benner and Tushman, 2003). Growth is, in fact, portrayed as an opportunity cost in a sense that firms that are heavily focused on achieving operational excellence may fail to take advantage of available growth opportunities. Such firms are said to be process-management-driven and focused on perfecting their current modus operandi in a rather inward-looking fashion (Adler et al., 2009). As such, they are criticized for being at risk of growing so focused on process mapping, improvement, and control that they become too rigid to recognize, let alone seize growth opportunities as and when they arise (Benner and Tushman, 2003). Assuming that is true, one could then contend that firms with different growth prospects will have different growth-related opportunity costs and, thus, different long-term downsides to operational excellence – with the ones with the greatest growth opportunities suffering the highest opportunity cost. Accordingly, stock market participants are likely to interpret a firm's operational excellence signal differently depending on their expectations of the firm's short-term revenue growth.

When growth expectations are high, the stock market will be less eager to reward operational excellence than it would revenue growth. Operational excellence may, in fact, be viewed as a hindrance to growth. A firm that scores high on operational excellence may be viewed as favoring margin preservation over market share gains, and forgoing growth opportunities in the process. In the same vein, operational excellence could be viewed as a reflection of excessively lean operations (Eroglu and Hofer, 2011) that may translate into lost sales in the immediate term, with negative long-term ripple effects on customer loyalty and future revenue generation (Moussaoui et al., 2016). Conversely, low operational excellence under conditions of high revenue growth expectations may be tolerated on the premise that a lack of short-term efficiency and operating profitability can be justified by the firm's pursuit of growth opportunities and long-term value creation.

> **H2**: Stock market expectations of short-term firm revenue growth will negatively moderate the relationship between achieved operational excellence and anticipated long-term value creation.

The moderating effect of firm R&D efforts

The productivity dilemma argument suggests that firms pursuing operational excellence may achieve efficiency, effectiveness, and operating profitability in the short term, but may also grow too rigid to adapt to changing market conditions in the long term (Adler et al., 2009). Efforts meant to enhance operational excellence are said to induce routinization dynamics that cause firms to overcommit to modi operandi that gradually lose relevance as markets evolve (Benner and Tushman, 2003; Wagner et al., 2012).

Firms that engage in R&D efforts are better positioned to mitigate that risk of rigidity and gradual obsolescence. R&D efforts are means of experimentation that ensure a steady flow of new ideas into the organization (March, 1991). Research on organizational change and adaptation suggests that R&D efforts enable organizations to enrich their knowledge pool and stay current on relevant market developments (Cohen and Levinthal, 1990; Zahra and George, 2002) with a positive impact on strategic adaptability (Hoang and Rothaermel, 2010).

From a signaling perspective, firms that engage in R&D efforts while achieving high operational excellence show ambidextrous capabilities likely to be perceived by the stock market as positive signals for long-term value creation. Stock-market participants are fully aware of the dual exploitation-exploration mandate of organizations (Lavie et al., 2011; Stein, 1989). They are particularly attentive and responsive to signals of firm exploration (or lack thereof). Woolridge and Snow (1990) show a strong positive relationship between a firm's strategic R&D efforts and its stock market valuation. Similarly, Stein (1989) shows the stock market to be efficient in detecting signals of an overemphasis on short-term outcomes – such as operational excellence – at the expense of exploratory efforts – such as R&D – meant to enhance the odds of sustained long-term value creation. Firms that achieve short-term profitability by cutting discretionary R&D expenditures are viewed by market participants as jeopardizing long-term value creation and are penalized accordingly (Gentry and Shen, 2013; Stein, 1990). Conversely, firms that engage in exploration through R&D efforts while showing a strong ability to run their day-to-day operations efficiently, effectively, and profitably are viewed as ambidextrous and more conducive to long-term value creation.

H3: Firm R&D efforts will positively moderate the relationship between achieved operational excellence and anticipated long-term value creation.

Data and measurement

To test the proposed hypotheses, a panel data set was compiled following the procedure outlined in Figure 2. The initial sample consisted of all publicly traded manufacturing firms (i.e., NAICS codes 31-33) listed on the NYSE, NYSE MKT (formerly AMEX), or NASDAQ exchanges between 2010 and 2015. This time period corresponds to the most recent window that is long-enough for the purpose of this study and void of major exogenous shocks (e.g., the 2008 financial crisis) that could otherwise influence the relationships under investigation. From an initial sample of 2,353 firms and 11,707 firm-year observations, I proceeded to exclude firms with particularly high R&D expenditures, low market capitalizations and limited analyst coverage: the rationale behind the exclusion of firms with R&D expenditures greater than sales is that firms with such a high R&D intensity tend to be research firms with limited manufacturing operations (e.g., Gentry and Shen, 2013). Firms with market capitalizations of less than $300 million (often referred to as micro and nano caps) or average annual sales of less than $10 million were removed from consideration since such small firms are often subject to infrequent and/or speculative trading that distorts their market values (e.g., Kim and Bettis, 2014). Lastly, I excluded firms that are followed by fewer than five analysts, as is common in similar studies (e.g., Loh and Mian, 2006; Mikhail et al., 1999). Greater analyst coverage ensures investor scrutiny and strengthens signal-based assessment models as it facilitates the faster dissemination and assimilation of firm financial signals (Hong et al., 2000). After this screening procedure and the exclusion of observations with missing data, the final sample consists of an unbalanced panel of 864 firms with a total 3,128 firm-year observations. Figure 3 provides the breakdown of sampled firms by industry at the 3-digit NAICS code level. Although the sample spans a wide range of manufacturing industries, it remains dominated by four industries collectively representing two thirds of sampled firms.

Figure 2 – Sampling procedure

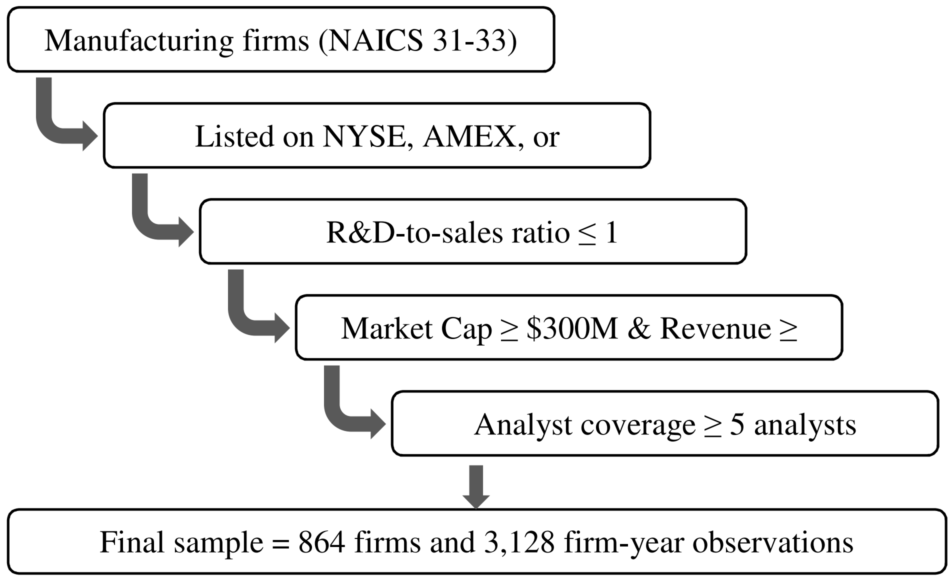
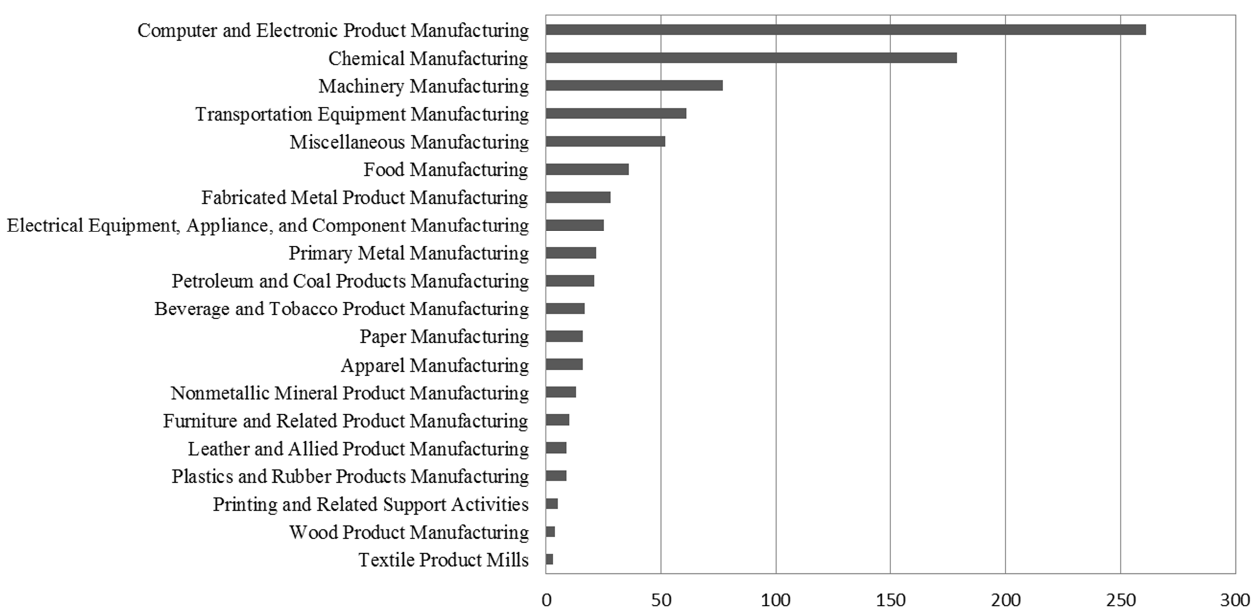


Figure 3 – Number of sampled firms by industry



Three data sources were used to construct the measures for the dependent, independent and control variables. First, the COMPUSTAT database was used to collect firm accounting data. Second, the CRSP (Center for Research in Security Prices) database was used to collect firm historical stock prices and dividend distributions, as well as market index levels. Third, the I/B/E/S (Institutional Brokers' Estimate System) database was used to collect analyst estimates of future firm revenues.

Dependent variable

A firm's long-term value creation potential has been measured in a variety of ways in the extant literature. Although researchers have used both objective and subjective measures, the latter are more commonly employed in research studying privately held companies and individual business units of larger conglomerates (e.g., Dess and Robinson, 1984; Fang et al., 2007). Objective measures of long-term value creation are mostly market-based (e.g., Hillman and Keim, 2001; Uotila et al., 2009). The tendency to use the stock market as a gauge for the long-term value creation potential of organizations is premised on the efficient market hypothesis, which stipulates that the stock market efficiently evaluates future cash flows of organizations and appropriately prices them in the long run (Fama, 1998). Most market-based measures are, therefore, forward-looking and capture the long-term value creation potential of organizations.

In this study, I use the price-to-sales (P2S) ratio to assess a firm's long-term value creation potential. This valuation metric is popular in research and industry as a measure of the stock market's expectation of a firm's long-term value creation potential (e.g., Brunnermeier and Nagel, 2004). P2S expresses a firm's market capitalization as a multiple of the firm's most recent annual sales. It reflects the stock market's anticipation of the firm's ability to convert sales proceeds into positive cash flows into perpetuity. The P2S ratio is preferred over other popular financial multiples for the purposes of this study because it assumes business continuity and accommodates the assessment of firms with negative earnings, unlike price-to-book and price-to-earnings respectively (e.g., Brunnermeir and Nagel, 2004; Purnanandam and Swaminathan, 2004). The price-to-sales ratio (P2S) for firm i is measured over the firm's first fiscal quarter of fiscal year t+1 as follows:

$$\mathrm{P2S}_{\mathrm{iQ1|FY_{t+1}}} = \frac{\mathrm{MktCap}_{\mathrm{iQ1|FY_{t+1}}}}{\mathrm{Sales}_{\mathrm{iFY_t}}}$$

where $\mathrm{MktCap}_{\mathrm{iQ1|FY_{t+1}}}$ is firm i's average market capitalization during the first quarter following the firm's most recent fiscal-year end (i.e., $\mathrm{Q1|FY_{t+1}}$), and $\mathrm{Sales}_{\mathrm{iFY_t}}$ is firm i's annual sales in the most recent closed fiscal year ($\mathrm{FY_t}$). $\mathrm{MktCap}_{\mathrm{iQ1|FY_{t+1}}}$ is in turn measured as follows:

$$\mathrm{MktCap}_{\mathrm{iQ1|FY_{t+1}}} = \sum_{j}^{n} \frac{\mathrm{p_{ij}} * \mathrm{SharesOutstanding_{ij}}}{\mathrm{n}}$$

where p_{ij} is firm i's closing stock price on trading day j of $\mathrm{Q1|FY_{t+1}}$, $\mathrm{SharesOutstanding}_{ij}$ is the number of firm i shares outstanding in trading day j, and n is the total number of days firm i traded during $\mathrm{Q1|FY_{t+1}}$. Sales figures were retrieved from the COMPUSTAT database. Stock prices and daily numbers of shares outstanding were obtained from the CRSP database.

P2S ratios are measured using the firm's average market capitalization over Q1|FY+1 instead of the entire year following the most recent fiscal year-end in order to eliminate the confounding effects of subsequent quarterly earnings announcements on the market's assessment of the firm's long term value creation potential. As prior research has shown, markets adjust their assessment of long-term value as new material information, such as that contained in earnings announcements, becomes available (Beaver, 1968).

A myriad of alternative market-based measures of long-term value creation have been used in prior research. The most common ones include Tobin's Q and excess returns. While both present benefits, they suffer shortcomings that make unsuitable for the current study. Tobin's Q (Brainard and Tobin, 1968) is the ratio of outstanding financial claims on an organization over the current replacement costs of the organization's assets. A major downside to Tobin's Q is that its denominator is difficult to estimate. Not only is it challenging to assess the value of intangible assets (Hillman and Keim, 2001), it is also extremely difficult to accurately evaluate the current replacement costs of assets (Lewellen and Badrinath, 1997). Most of the literature uses a workaround approach to estimate the ratio's denominator by using firm book value as a proxy (e.g., Richard et al., 2007), but this approach has been deemed inadequate in prior research (Lewellen and Bardinath (1997).

Excess returns, on the other hand, measure the marginal return of a company's stock above and beyond what is expected of companies with similar levels of volatility (e.g., McDonald et al., 2008). This measure is inherently backward-looking as it captures a stock's performance over a given period in the past. It is also ambiguous as to whether such past performance can be indicative of future performance (Grinblatt and Moskowitz, 2004). In addition, excess returns are often used as a proxy for a firm's short-term rather than long-term value creation (e.g., Li and Tallman, 2011).

Independent variables

Operational excellence is inherently multidimensional and context-specific. Different measures have been used in the OM literature to assess different aspects of operational excellence. From inventory levels and order variability (Tsay and Lovejoy, 1999) to capacity allocation (Cachon and Lariviere, 1999) and order cycle time (Hult, Ketchen, and Slater, 2004), the measures abound and vary by context and research question. In an attempt to create an integrative multidimensional measure that captures the essence of operational excellence in the manufacturing context, Bharadwaj et al. (2007) developed an index score combining three objective metrics of operational performance – i.e., inventory turns, on-time (backlog) ratio, and gross margin. The measure is appropriate for the current study because it captures the three key dimensions of operational excellence as conceptualized in this study – i.e., efficiency, effectiveness, and operating profitability. It is also appropriate because it was developed specifically for the manufacturing context, which is the focus of this study. In order to minimize the number of instances of undefined ratios because of a zero denominator (e.g., inventory turns for a company that reports no inventory), an adapted version of Bharadwaj et al.'s (2007) measure is used. Instead of inventory turns, I use inventory-to-sales ratio; and instead of on-time ratio, I use backlog ratio calculated as the ratio of backlogs to the sum of backlogs and sales per fiscal year. I also use (1-gross margin) instead of gross margin in order to scale all three dimensions in the same direction. Since the three metrics have disparate scales, I converted them into t-scores at the 3-digit-NAICS-code level for each year of the sampling period. This transformation puts all three components of the Operational Excellence variable on equal footing and effectively ensures that no one component dominates the overall index score. It also enables the adjustment for inter-industry differences by evaluating firms within their respective 3-digit-NAICS codes (e.g., York and Miree, 2004). The final index score is then constructed as the sum of the three metrics multiplied by -1 such that higher scores represent greater operational excellence. All three metrics are constructed from data available in the COMPUSTAT database.

Firm Short-Term Growth Expectation is measured as the ratio of the equity analyst consensus estimate of firm revenues for fiscal year t over the firm's actual revenues in fiscal year t-1. Consensus estimates are calculated as the simple average of estimates issued by all analysts following the firm during the last month of the firm's fiscal year (Bowers et al., 2014). Prior research recommends using consensus estimates from the last fiscal month for their richer information content (McNichols, 1989) and increased accuracy (Kasznik and Lev, 1995). Analyst estimates are retrieved from the I/B/E/S database.

Firm R&D Efforts is operationalized using an industry-adjusted version of the customary R&D intensity measure – i.e., the ratio of firm research and development expenditures to firm total sales in fiscal year t (e.g., Baysinger and Hoskisson, 1989). The ratio reflects the extent to which a firm reinvests sales proceeds into exploratory initiatives meant to improve the firm's long-term value creation prospects. Because R&D expenditures can vary significantly across industries, it is important to control for unobserved industry effects. As such, each firm-year R&D intensity measure is converted into a t-score at the 3-digit NAICS code level for each year of the sampling period, in the same way I converted the three components of the operational excellence measure. R&D expenditures and sales data were retrieved from the COMPUSTAT database.

Control variables

Three firm and market factors known to influence firm market capitalization are used as control variables in this study. First, I control for revenue surprise – i.e., the extent to which a firm's revenue for the fiscal year differs from the most recent equity analyst consensus estimate. Analyst estimates are a major determining factor in the valuation of public equities (Bowers et al., 2014). They represent a vital source of information about the probable financial condition of public corporations ahead of quarterly earnings announcements (Gleason and Lee, 2003). As such, they are closely watched by the investment community and serve as a guidepost in the price discovery process (Kasznik and McNichols, 2002). Firms that meet or exceed expectations tend to see a positive market reaction in the form of stock price appreciation, whereas firms that miss expectations tend to experience a drop in the value of their stock (Kasznick and McNichols, 2002). In this study, I control for Revenue Surprise – i.e., the difference between actual revenues and the consensus revenue estimate (Alan et al., 2014).

Second, I control for dividend yield in the first quarter following the current fiscal year. Firm long-term value (as reflected in its stock price) is often calculated as the net present value of future cash flows (Brealey et al., 2012). When a firm distributes a dividend, it reduces the amount of future cash flows by an equivalent amount. As such, equity prices should adjust down any time a dividend is accrued, and they should do so by the amount of the dividend (Bali and Hite, 1998). Dividend Yield is calculated as the ratio of quarterly ordinary dividends to the firm's average market capitalization in the first quarter of fiscal year t+1 (i.e., $\mathrm{Q1|FY_{t+1}}$).

Third, I control for the overall stock market performance. Asset pricing models such as the CAPM (Capital Asset Pricing Model) suggest that individual stock prices are driven by idiosyncratic firm characteristics as well as overall market conditions and returns (e.g., Lintner, 1965). Overall market returns are measured as the rate of return of the S&P 500 index contemporaneous to $\mathrm{Q1|FY_{t+1}}$ – i.e., the quarter when the dependent variable is measured for each firm i. For clarity, the timeline of measurement of the dependent, independent, and control variables is summarized in Figure 4. Descriptive statistics and pairwise correlations are provided in Table 1.

Figure 4 – Variable measurement timeline

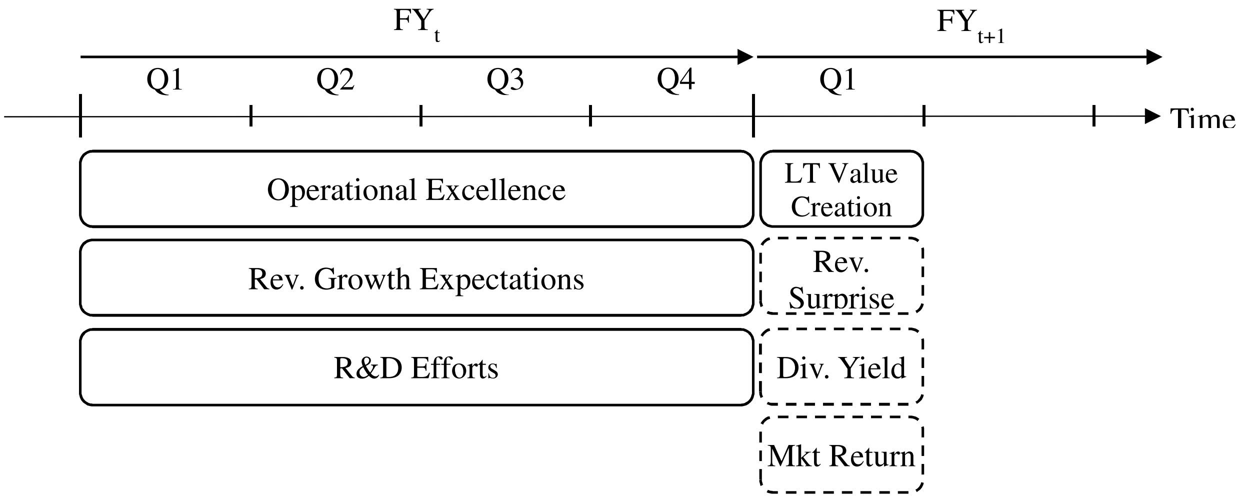


Table 1 - Descriptive statistics and pairwise correlations

Variable/construct	Obs.	Mean	s.d.	1	2	3	4	5	6
1 . Price-to-Sales Ratio	3128	2.693	3.753						
2 . Revenue Surprise	3128	0.002	0.030	0.137 *					
3 . Dividend Yield	3128	0.003	0.008	-0.093 *	-0.014				
4 . Market Return	3128	1.127	0.059	0.091 *	-0.014	-0.023			
5 . Operational Excellence	3128	2.142	4.884	0.161 *	0.043 *	0.016	-0.137 *		
6 . Short-term Revenue Growth Expectations	3128	1.256	3.426	0.063 *	0.074 *	-0.021	-0.007	0.052 *	
7 . R&D Efforts	3128	-0.411	12.523	0.342 *	0.066 *	-0.051 *	0.000	-0.046 *	0.064 *

** Significant at the 0.05 level*

Model specification and estimation

As mentioned earlier, the dataset used in this study consists of an unbalanced panel of 864 firms and 3,128 firm-year observations over the period 2010-2015. As such, I first test for the presence of panel effects: a Breusch-Pagan Lagrange Multiplier (BPLM) test indicates that the variance across panel units is not zero, providing evidence for the presence of panel effects ($\chi^2 = 853$; p-value<0.001). The Wooldridge's Lagrange Multiplier test, in turn, provides evidence for first-order autocorrelation of residuals (F-statistic = 4.08; p-value=0.04), prompting us to model errors as an AR(1) process.

Besides panel effects, I also recognize the concern of omitted variable bias. Many unmeasured phenomena could potentially have an effect on the dependent variable. Such omitted variables are problematic as they cause estimates to be biased. When that is the case, using a fixed-effects (FE) model corrects for the bias by adding unit-level dummy variables. While the FE method can be effective in producing unbiased estimates, it is substantially less efficient than random-effects (RE) modeling. It is common practice for scholars to run a Hausman test to assess whether an FE or an RE model is superior for the dataset at hand. Despite the ubiquity of this practice, however, many scholars have spoken against its adequacy (e.g., Bell and Jones, 2015). In fact, some said that "it is 'neither necessary nor sufficient' (Clark and Linzer 2012, 2) to use the Hausman test as the sole basis of a researcher's ultimate methodological decision" (Bell and Jones, 2015, p.139). The decision should depend on contextual and theoretical considerations that go beyond the Hausman test, as long as the covariates used in the model are not correlated with the residuals of the RE model (Kennedy, 2003). As such, the ultimate test for whether or not RE modeling is appropriate is to run pairwise correlations between the RE model's residuals and the model's covariates. Doing so for the current study's dataset reveals that only one variable is correlated (r = - 0.079; p-value<0.001) with the residuals. As such, there is no strong statistical basis for preferring an FE over an RE model for the dataset at hand; even more so that there is a strong theoretical and contextual rationale for using an RE model. RE models are used to explain long-run effects while FE models are used to explain short-run effects (Kennedy, 2003). Given the long-run nature of the relationships under investigation in this study, an RE model is deemed appropriate. Therefore, the following random-effects model with AR(1) disturbances is estimated using the xtregar procedure in STATA:

$$\begin{aligned} \mathrm{P2S}_{\mathrm{iQ1|FY_{t+1}}} = \mu &+ \alpha_1 \mathrm{RevenueSurprise}_{\mathrm{iFY_t}} + \alpha_2 \mathrm{DividendYield}_{\mathrm{iQ1|FY_{t+1}}} \\ &+ \alpha_3 \mathrm{S\&P500RateOfReturn}_{\mathrm{iQ1|FY_{t+1}}} + \alpha_4 \mathrm{OpEx}_{\mathrm{iFY_e}} \\ &+ \alpha_5 \mathrm{RevGrowthExpectations}_{\mathrm{iFY_t}} + \alpha_6 \mathrm{R\&D2Sales}_{\mathrm{iFY_t}} \\ &+ \alpha_7 \mathrm{OpEx} * \mathrm{RevGrowthExpectations}_{\mathrm{iFY_t}} + \alpha_8 \mathrm{OpEx} * \mathrm{R\&D2Sales}_{\mathrm{iFY_t}} \quad + (\mu_e \\ &+ \varepsilon_{\mathrm{iFY_{t+1}}}) \end{aligned}$$

where μ is the overall intercept term and $(\mu_i + \varepsilon_{iFY_{t+1}})$ is a composite error term comprising a random intercept component (μ_i) measuring the extent to which firm i's intercept differs from the overall intercept μ, and a within-firm disturbance component ($\varepsilon_{iFY_{t+1}}$) reflecting the random deviation of firm i form the sample average in period t+1. $\varepsilon_{iFY_{t+1}}$is modeled as an AR(1) process due to the presence of first-order autocorrelation.

In an effort to ascertain the validity and robustness of the above RE model, a between-effects (BE) model was also estimated. Between-effects models collapse time-series values of the dependent and independent variables into single average values for each panel unit (i.e., each firm in this study) and run a cross-sectional OLS regression on the transformed data (Kennedy, 2003). As such between-effects models ignore short-run, within-unit variances and exclusively analyze cross-sectional (i.e., between) variance (Kennedy, 2003).

Results

The empirical results are presented in Table 2. Panels A and B, respectively, show the main-effect and full-model results of the autoregressive random-effects model. Panels C and D, in turn, show the equivalent estimates of the between-effects model analyzed to assess the robustness of the random-effects results.

Starting with panel A, all three controls have their expected signs – with two being statistically significant. In line with expectations, firm revenue surprise is found to positively influence the stock market's assessment of long-term value creation ($\alpha 1 = 4.028$; $p = 0.005$). The S&P 500 rate of return is also found to have a similarly positive effect ($\alpha 3 = 3.672$; $p<0.001$). Dividend yield is not found to have a significant impact on the stock market's anticipation of firm long-term value creation. Regarding the main independent variable of interest, the positive and statistically significant coefficient estimate of Operational Excellence ($\alpha 4 = 0.035$; $p = 0.001$) suggests that the stock market views operational excellence as a positive signal for firm long-term value creation, thus providing support for Hypothesis 1.

In Panel B, interaction terms are added to assess how market- and firm-level characteristics moderate the relationship between operational excellence and long-term value creation. Hypothesis 2 proposes that the stock market will view operational excellence less positively the more optimistic it is about a firm's short-term revenue growth prospects. The estimation results provide support for this hypothesis, as evidenced by the negative and statistically significant coefficient estimate of the interaction term between operational excellence and short-term revenue growth expectations ($\alpha_7 = -0.006$; $p = 0.008$). This finding is of particular interest because it provides a boundary condition to the long-term value creation potential of operational excellence.

Table 2 – Estimation results; DV = Firm price-to-sales ratio

Variables	Random effects with AR(1) disturbances		Between effects	
	A	**B**	**C**	**D**
Intercept	-1.327 **	-1.478 **	-27.244 ***	-27.751 ***
	(0.666)	*(0.677)*	*(5.077)*	*(5.006)*
Control Variables				
Revenue Surprise	4.028 ***	4.633 ***	17.051 ***	14.543 ***
	(1.431)	*(1.453)*	*(4.336)*	*(4.330)*
Dividend Yield	-8.398	-8.700	-74.707 ***	-67.269 ***
	(5.281)	*(5.355)*	*(23.471)*	*(23.147)*
Market Return	3.672 ***	3.752 ***	26.511 ***	26.932 ***
	(0.577)	*(0.587)*	*(4.495)*	*(4.432)*
Independent Variables				
Operational Excellence (OpEx)	0.035 ***	0.036 ***	0.193 ***	0.185 ***
	(0.010)	*(0.010)*	*(0.030)*	*(0.030)*
Revenue Growth Expectations	0.022	0.067 ***	-0.003	0.029
	(0.017)	*(0.024)*	*(0.021)*	*(0.031)*
R&D Efforts	0.098 ***	0.098 ***	0.117 ***	0.110 ***
	(0.007)	*(0.007)*	*(0.010)*	*(0.010)*
Interactions				
OpEx * Rev. Growth Expectations		-0.006 ***		-0.011 *
		(0.002)		*(0.006)*
OpEx * R&D Efforts		0.002 **		0.011 ***
		(0.001)		*(0.002)*
R^2	0.151	0.163	0.146	0.164
Wald χ^2	267.580 ***	291.910 ***	-	-
F-statistic	-	-	45.590 ***	39.000 ***
# of Observations	3128	3128	3128	3128
# of Firms	864	864	864	864

Standard errors between parentheses; *p < 0.1; **p < 0.05; ***p < 0.01

The second moderating effect pertains to firm R&D efforts. Hypothesis 3 suggests that firm R&D efforts will amplify the stock market's positive assessment of operational excellence as an effective instrument for long-term value creation. The estimation results provide support for the hypothesis as shown by the positive and statistically (marginally) significant coefficient estimate of the interaction term between operational excellence and firm R&D efforts (α_8=0.002; p=0.069). In line with the organizational ambidexterity literature, this finding indicates that capital markets do indeed put a premium on organizations that balance exploitative and exploratory initiatives.

The empirical results from panels C and D provide further support for the aforementioned findings. As stated earlier, between-effects analyses were undertaken to ascertain the validity and robustness of the random effects estimates. Such consistency of findings speaks to the robustness of the empirical results to variations in estimation techniques.

Discussion and conclusion

This research explores the stock market's ex-ante assessment of operational excellence as a long-term value creation instrument in the manufacturing sector. The study's findings provide empirical evidence for a positive assessment; firms that demonstrate higher levels of operational excellence are valued at a premium compared to peers. Based on the estimation results, the stock market puts a 6.5% premium on firms that are one standard deviation above average on the operational excellence scale, all else equal. This finding carries substantial economic significance and reflects the stock market's positive outlook on the operational achievement's long-term value creation potential. It also echoes a sentiment shared by a DuPont executive that "operational excellence is one of the most important contributors to an organization's sustainable performance and growth" (Rains, 2014, p.1).

The stock market does acknowledge, however, that the anticipated long-term benefits of operational excellence are not of equal magnitude across contexts. In fact, it is shown that stock market participants tend to reward operational excellence significantly less under conditions of abundant growth opportunities. The more analysts expect a firm to grow its revenues in the short term, the less favorably the stock market views its operational excellence as an instrument for long-term value creation; and the lower a premium it puts on the operational achievement. This finding indicates that operational excellence under conditions of abundant growth opportunities is viewed as a sign of misaligned priorities whereby market share gains may be sacrificed in an overzealous and counterproductive pursuit of short-term operational excellence. Conversely, when markets are more mature and growth opportunities more scarce, the stock market tends to reward operational excellence significantly more generously.

The third key finding of this research pertains to the amplifying effect of firm R&D efforts on the stock market's positive assessment of operational excellence as an instrument for long-term value creation. One explanation of this finding is that market participants view firm exploratory efforts as a hedging mechanism that helps mitigate the risk of competency traps (Levitt and March, 1988). Firms that fail to engage in such efforts are viewed as myopic and at risk of becoming overinvested in process management capabilities that may lose relevance in the long term (e.g., capabilities related to the manufacturing of internal combustion engines in the automotive industry). Firms that invest in R&D signal a willingness to experiment with new ideas and may, hence, be viewed as less likely to suffer the negative effects of entrenched routinization dynamics (Cohen and Levinthal, 1990). Such experimentation efforts enrich the firm's knowledge pool and enhance its adaptive capabilities (March, 1991), with a positive impact on long-term value creation.

Taken together, the study's findings indicate that the stock market views operational excellence as inherently beneficial to firm long-term value creation. The results also indicate that the market's positive outlook is adjusted based on strategic fit and firm exploratory efforts. Firms that aggressively pursue operational excellence under conditions of abundant growth opportunities signal strategic misfit and misaligned priorities that force a counterproductive tradeoff between operational excellence and firm revenue growth. Firms that fail to reinvest a sufficient amount of the proceeds of operational excellence in exploratory efforts are viewed as too short-term oriented, biased towards exploitation, and at risk of trading long-term viability for short-term profitability.

This research contributes to theory and practice in several ways. First, it advances our understanding of the strategic value of process management. By linking operational excellence to long-term value creation, this research provides evidence that process management practices are not necessarily myopic and counter-productive in the long run. It also indicates that the warnings voiced within the productivity dilemma literature may not be warranted as is, and should perhaps be redirected towards the improper implementation of process management practices instead of suggesting that the practices are intrinsically at odds with long-term value creation. Second, this research provides guidance for top managers as to the conditions under which the long-term value creation potential of (properly implemented) process management practices may be enhanced or dampened. As it stands, the extant literature is too coarse-grained and could induce suboptimal decision making and resource misallocation. Managers subscribing to the productivity dilemma narrative may unduly discount the long-term benefits of operational excellence and underinvest in process management as a result, while those subscribing to a contrary narrative may overcommit to process management practices beyond what relevant contingencies call for. This research provides the stock market's perspective on two major contingencies – firm short-term revenue growth prospects and firm R&D efforts – as a guidepost to help reduce the risk of suboptimal strategy formulations. Third, and in light of prior research showing the stock market's influence on top management teams and firm conduct (e.g., Gentry and Shen, 2013; Puffer and Weintrop, 1991), this research may provide a rationale as to why many top executives continue to emphasize process management practices and associated operational excellence as key enablers of sustained competitive advantage despite numerous warnings from the productivity dilemma literature.

We hope that this research will stimulate further investigation of the strategic value of operational excellence in particular and operations management in general. While the study presents evidence of moderating effects of the stock market's expectations of firm short-term revenue growth expectations and firm exploratory efforts, future research can explore other contingency factors that can further qualify the relationship between operational excellence and long-term value creation. Future studies may also consider developing context-specific conceptualizations and measurements for operational excellence. The three-dimensional conceptualization adopted in this paper has been developed for the manufacturing context and may not be as readily applicable to other contexts. Future studies may explore alternate conceptualizations and measurements – particularly in the service sector – to help advance our understanding of the strategic value of operational excellence across different contexts.

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IV. Essay 3 – Operations orientation pre and post market shifts: When the blessing turns into a curse

Abstract

Operations management capabilities are executional levers that facilitate the efficient and effective fulfillment of a firm's strategic promise. Their propensity to create value is, however, contingent on the continued appeal of the firm's strategic promise in the marketplace. When target customers deem the promise intrinsically appealing, operations management capabilities serve as compounding levers that enhance customer value creation and facilitate shareholder value appropriation. When the promise loses its appeal or ceases to trigger customer interest, as it often does when markets shift, the capabilities lose relevance and become less conducive to competitive advantage. This exploratory essay discusses the effects of a firm's pursuit of operations management capabilities as a primary competitive weapon (i.e., operations orientation) pre and post market shifts as well as the impact of such orientation on the firm's ability to adapt when customer preferences shift in material ways. Three research propositions are made for future investigation.

Introduction

Operations management capabilities are potent enablers of customer value creation (Langley and Holcomb, 1992) and a major source of competitive advantage (Hult et al., 2007). Companies such as Walmart, McDonald's, and Dell – to name a few – have notoriously leveraged such capabilities to propel themselves to the forefront of their respective industries. Walmart's ability to effectively and efficiently distribute a wide range of products across an expansive logistics network has largely contributed to the company's global leadership in retail (Barney, 2012). As of 2016, Walmart is by far the world's largest retailer by revenue, with global sales surpassing those of the next four competitors combined (Deloitte, 2017). Similarly, McDonald's global supremacy in the fast food industry is largely attributable to the company's streamlined operations and superior logistics and supply chain management capabilities. McDonald's promises its patrons speedy and consistent service anywhere in the world and leverages superior operations management capabilities and associated operational excellence to fulfill the promise. In some markets (e.g., the state of Florida in the US), it guarantees orders to be ready within 60 seconds – a performance unmatched by the closest competition (Wong, 2014). Lastly, Dell's rise to the top of the PC industry through the 1990's and early 2000's is often attributed to the company's successful pioneering of a direct-sales model and a build-to-order approach to PC manufacturing; both enabled by superior operations management capabilities (Gunasekaran and Ngai, 2005).

In recent years, however, all three companies have suffered strong competitive headwinds due to the emergence of innovative market alternatives with more attractive customer value propositions. Walmart's dominance in the retail industry is increasingly threatened by online retailers like Amazon as more shoppers find greater value in the online or mobile experience compared to brick-and-mortar stores. McDonald's value proposition centered around speed and consistency appears to be losing its appeal next to healthier yet equally accessible alternatives from competing chains such as Subway (e.g., Kowitt, 2014, Torres, 2016). And Dell's leadership in the PC market has long been eroded due to the company's failure to adapt its operations and supply chain management capabilities to the laptop market after a longstanding domination in the desktop segment (e.g., Darlin, 2006; Knowledge@Wharton, 2007).

Many of the challenges faced by these three companies—and others in similar situations—seem to be, at least partly, due to a lack of fit between legacy operations management capabilities and a new market reality. All three companies appear to have been blindsided by major market shifts caused by the emergence of alternative value propositions that rendered their own less attractive in the marketplace. As consumer preferences shifted, the companies' legacy operations management capabilities became less relevant and, hence, less conducive to competitive advantage. Walmart's ability to efficiently and effectively move product in pallets and case packs from manufacturers to stores through distribution centers proved of limited value in the online channel where products needed to be picked, packed, and shipped in individual units and delivered to customer-designated locations. Similarly, Dell's mass-customization strategy that proved effective in the desktop segment could not be replicated in the laptop market where the finished product was more compact and less amenable to delayed differentiation.

In this essay, I explore a key mechanism that causes firms to grow overinvested in obsolete operations management capabilities at the expense of strategic foresight and market adaptation. Market stability is suggested as a double-edged sword that, on the one hand, facilitates the successful leverage of operations management capabilities for enhanced customer value creation and shareholder value appropriation and, on the other hand, causes firms to potentially overestimate the sustainability of such benefits which may, ultimately, have negative ramifications for a firm's ability to adapt to subsequent changes in market conditions. In this essay, I first discuss the value creation potential of operations management capabilities. Then I discuss the proposed mechanism through which firms grow overinvested in obsolete operations management capabilities at the expense of strategic foresight and market adaptation. Three research propositions are made accordingly.

Operations management capabilities and value creation

Operations management capabilities are executional levers that enable the efficient and effective fulfillment of an organization's strategic promise (Adam and Swamidass, 1989; Mentzer et al., 2008). Their propensity to create value is, however, contingent on the continued appeal of the organization's promise in the marketplace. When target customers deem the promise intrinsically appealing, operations management capabilities serve as compounding levers (cf. Figure 1) that enhance customer value creation (e.g., affordability, service differentiation) and facilitate shareholder value appropriation (e.g., profitability).

Figure 1 – Operations management capabilities as compounding levers for customer value creation and shareholder value appropriation

When the promise loses its appeal or ceases to trigger customer interest, as it often does when markets shift, operations management capabilities that used to serve as valuable compounding levers become less relevant – simply because a promise deemed intrinsically unattractive will remain so regardless of the efficiency and effectiveness with which it is fulfilled.

The value creation of operations management capabilities can therefore be more or less transient depending on the level of stability[4] in a firm's product-market. Many scholars have argued that such capabilities are more likely to be beneficial under stable market conditions where a firm's promise remains relevant for an extended period of time (e.g., Miles et al., 1978; Benner and Tushman, 2003). Under such conditions, operations management capabilities are effective in creating and capturing value through incremental process improvements, efficiency enhancements, and service differentiation (Ahire and Dreyfus, 2000). When markets shift in material ways, however, an ex-ante focus on operations management capabilities becomes less conducive to competitive advantage and often turns into a source of rigidity that undermines organizational adaptation and long-term value creation (Benner and Tushman, 2003).

The fact that the value creation potential of any set of operations management capabilities is inherently transient has been recognized and extensively addressed by both scholars and practitioners (Hayes and Upton, 1998). Prior research addressing this risk of obsolescence has

[4] Markets are stable as long as no major disruption occurs whereby a dominant value proposition is existentially challenged. For example, the car market had been stable for decades until the dominant value proposition of human-driven, internal-combustion-engine vehicles started to be challenged by new comers offering fully-electric, self-driving vehicles as a more compelling mode of personal transportation. Similarly, the cell-phone manufacturing industry had been relatively stable until it was disrupted by the introduction of touch-screen, application-based smartphones.

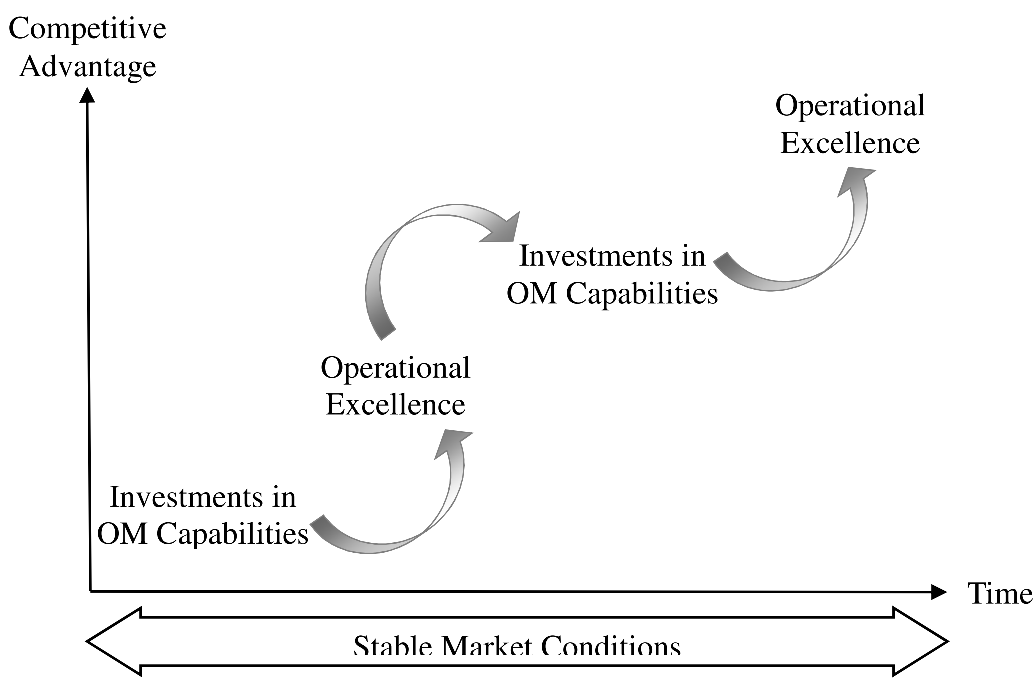
repeatedly prescribed that firms continuously revise and adjust their operational capabilities to keep pace with changing market dynamics (Brumme et al., 2015). Upton and Hayes (1998) argue that proper operations management requires ongoing invention to ascertain continued relevance of key capabilities. Similarly, practitioners acknowledge the need for adaptive capabilities in operations management. For example, Walmart CEO, Doug McMillon, recently commented that "retail history is very clear. Those that are unwilling or unable to change go away. (…) To win, we must run the business well today and change the business for the future" (Walmart, 2015).

However, such adaptability remains extremely challenging to develop and maintain due to various structural and behavioral inhibitors (e.g., Hayes and Upton, 1998). One such inhibitor, I argue, is the conditioning mechanism that takes place under stable market conditions. Essentially, I contend that market stability has a biasing effect on organizational sense-making (Weick, 1995) whereby firms develop exaggerated associations between a narrow set of operations management capabilities and sustained competitive advantage. The argument is that the longer a firm operates under stable market conditions, the more conditioned it becomes to associating operations management capabilities with operational excellence and superior performance. As such, market stability is argued to induce a strong operations orientation with a substantial risk of overinvestment in inferior/obsolete operations management capabilities.

On the risk of overinvestment in obsolete operations management capabilities

An organization's overinvestment in obsolete operations management capabilities is inherently accidental; it iteratively and unintentionally develops over time in a self-reinforcing cycle that takes hold under stable market conditions. When markets are stable, initial investments in operations management capabilities tend to improve operational excellence and generate favorable short-term performance outcomes (Benner and Tushman, 2003). As a result, organizations are compelled to further invest in the same capabilities in hopes of duplicating the initially observed performance benefits (Levitt and March, 1988). With more investments, operational excellence continues to improve and performance gains continue to follow – making additional investments all the more compelling, and creating momentum for a self-reinforcing cycle iterating additional investments, operational excellence, and performance gains (cf. Figure 2).

Figure 2 – The virtuous cycle of investments in operations management (OM) capabilities under stable market conditions



After a few iterations, the link between operational excellence and performance gains becomes increasingly perceived within the organization as more systematic than it actually is. While this overconfidence in the virtuous nature of the cycle may not be problematic under stable market conditions, it becomes extremely so when markets shift.

When a shift occurs, the virtuous cycle is broken and performance gains no longer follow from additional investments in existing operations management capabilities. Yet, the organization is too conditioned to change course (Walsh and Ungson, 1991). It mindlessly extrapolates past realizations into the future (Levinthal and March, 1993) and continues to invest, in an escalation of commitment to old routines that have proven effective in the past but may not be as effective in a post-shift environment (Staw, 1981). Ultimately, the organization becomes overinvested in inferior operations management capabilities, and falls into a competency trap as a result (Levitt and March, 1988).

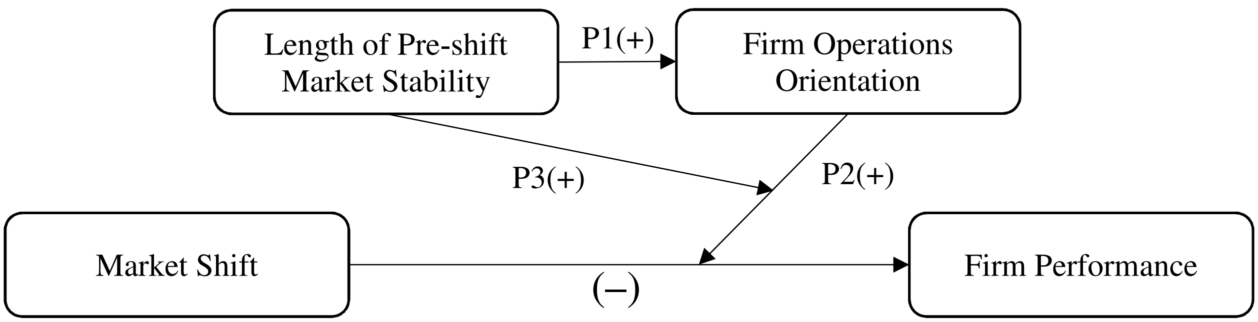
To illustrate, consider the example of McDonald's whose promise of speed, taste, and consistency had been – until very recently – intrinsically appealing to a growing customer base. As customers showed interest, McDonald's superior operations and supply chain management capabilities amplified customer value creation through competitive pricing and service differentiation and improved shareholder value appropriation through enhanced profitability. In recent years, however, the company's promise came under pressure due to the emergence of healthier market alternatives. A significant portion of the company's customer base shifted to healthier eating (Kowitt, 2014) and no longer considered the company's promise as intrinsically appealing. Speed and consistency were no longer sufficient to sustain customer interest; many customers expected fresh and healthy eating, in addition to speed and consistency. This shift in consumer preferences caused McDonald's to suffer a significant decline in in same-store sales (Strom, 2012) as it rendered the company's existing operations and supply chain management capabilities less conducive to competitive advantage due to their limited capacity to efficiently and effectively accommodate locally sourced fresh ingredients.

Yet, after years of successfully leveraging the same speed- and consistency-enabling operations and supply chain management capabilities, McDonald's had grown conditioned to view operational excellence as universally effective in mitigating (almost) all competitive challenges. As such, the company's initial reaction to the decline in same-store sales was to further invest in operational excellence so as to reduce order processing time (Kowitt, 2014). It even instituted a 60-second-or-less guarantee whereby customers were promised a free sandwich if they did not receive their food within 60 seconds (Wong, 2014). But sales continued to decline. What the company failed to realize was that sales were declining not because orders were not filled fast enough, but because consumers were shifting to healthier dining options (Kowitt, 2014). In a sense, the company's initial operational excellence core competency turned into a core rigidity and hindered the company's strategic foresight and market adaptation. McDonalds eventually recognized the shift in consumer preferences and initiated efforts to amend its menu accordingly, after many years of maladaptive behavior (Snyder, 2016).

Research propositions

The above discussion addresses some strategic limitations of the pursuit of operations management capabilities as a means to achieve operational excellence and facilitate superior customer value creation and shareholder value appropriation. The central argument is that such a pursuit may be so effective under stable market conditions that it causes organizational sense-making to grow biased towards an exaggerated association between existing operations management capabilities and competitive advantage. Market stability is argued to serve as a double-edged sword that, on the one hand, provides an ideal environment for the effective leverage of operations management capabilities and associated operational excellence to boost firm performance and, on the other, causes firms to become overinvested in a narrow set of such capabilities with negative ramifications on firm strategic foresight and market adaptation. Three distinct evolutionary dynamics composing this process can be identified as shown in Figure 3. They develop sequentially before, during, and after structural market shifts, and have the potential to collectively increase the risk of rigidity and organizational maladaptation in the face of radical shifts. In extreme cases, they can lead firms to grow out of sync with their competitive environments and eventually fade into irrelevance as a result.

Figure 3 – Conceptual model



Phase I: Market stability and operations orientation

Numerous schools of thought in organization theory suggest that firms are largely shaped by the environment in which they operate (e.g., DiMaggio and Powell, 1983; Fiol and Lyles, 1985; Pfeffer and Salancik, 2003). Resource dependence theory, for example, suggests that firms are open systems subject to conflicting pressures from various interest groups and that a key mission of top management teams is to channel those pressures in a way that best facilitates the attainment of organizational goals (Pfeffer and Salancik, 1978). One way top management teams channel such pressures is by adjusting their attention and resource allocation based on the intensity of each pressure (Ocasio, 1997). For example, in environments characterized by strong competitive pressures such that existing value propositions are repeatedly challenged and dethroned by new ones (e.g., the computing and digital storage industry), top management teams are compelled to dedicate substantial resources and attention to environmental scanning and competitive monitoring in order to safeguard their market position and ensure the continued relevance of their firm's value proposition (Miles et al., 1978). Conversely, in more stable markets where a mainstream value proposition has little to no existential threat to its continued appeal (e.g., as is the case in the waste management industry), top management teams are generally less inclined to engage in competitive monitoring and more likely to focus on internal process improvements and operational excellence as a means to create superior value and help strengthen their firm's market position (Carpenter and Westphal, 2001). With such a focus, and given that process management and associated operational excellence tend to yield satisfactory results under conditions of market stability (Benner and Tushman, 2003), firms will tend to gradually gravitate towards a stronger reliance on operations management capabilities as a primary source of competitive advantage, for as long as their markets remain stable. This is in line with propositions from the organizational learning literature suggesting that firm conduct tends to be governed to a large extent by trial-and-error feedback loops whereby past actions that fail to yield desired outcomes are abandoned and successful ones (e.g., investments in operations management capabilities under stable market conditions) are repeated (Levitt and March, 1988). As such, I propose that firms will invest more and more heavily in operations management capabilities and associated operational excellence as their markets remain stable.

> **Proposition 1**: Market stability will be positively associated with a firm's pronounced emphasis on operations management capabilities as a major source of competitive advantage - i.e., firms will develop a stronger operations orientation the longer their markets remain stable.

Phase II: Operations orientation and reduced market awareness

As firms develop a stronger operations orientation, they become more concerned with "the internal control of the firm and the governance of its activities" (Reed et al., 1996, p. 180).

As such, they tend to design most organizational roles for intra-organizational coordination, with only limited efforts expended in the development of boundary-spanning communication channels (Aldrich and Herker, 1977). They also allocate more of their available resources to improving existing processes than to scanning the environment for competitive threats and market opportunities (Aldrich and Herker, 1977).

While such an internal focus can be effective in stable market conditions (e.g., Carpenter and Westphal, 2001; Dean and Sharfman, 1996), it has the potential to significantly impair firm competitive awareness and adaptive capabilities. Miles et al. (1978) argue that defender firms with an operations orientation and an internal focus are at the mercy of market stability; they can only generate positive returns on their narrow focus to the extent that no major market shift occurs. When a shift occurs, however, firms with such an orientation are often blindsided by the turn of events and suffer significant performance losses as a result.

Proposition 2: Operations orientation is negatively associated with a firm's ability to foresee and/or adapt to structural market shifts

Phase III: Length of pre-shift market stability and firm maladaptive behavior

As discussed earlier, market stability not only induces firms to develop a pronounced operations orientation but also triggers a self-reinforcing process whereby incremental investments in operations management capabilities enhance operational excellence, which in turn strengthens firm competitive advantage. Over time, this iterative cycle starts to act as a conditioning mechanism that causes firms to ultimately elevate operations management capabilities and associated operational excellence from a means-to-an-end to an end in and of itself. In this essay, I argue that the longer a firm's market remains stable, the stronger the conditioning gets and the more entrenched the firm's beliefs in associating a narrow set of operations management capabilities with performance gains. As such, length of market stability is expected to exacerbate firm maladaptive behavior as discussed in proposition 2 above.

Proposition 3: Firm maladaptive behavior (P2) is exacerbated by the length of pre-shift market stability

Discussion and conclusion

This essay provides a brief account of an evolutionary mechanism that has the potential to cause firms to grow overinvested in operations management capabilities and associated operational excellence at the expense of strategic foresight and market adaptation. Such firms are said to be particularly vulnerable to structural market shifts. In extreme cases, they may be irreversibly blindsided by unfavorable market developments and may fade into irrelevance as a result. For example, Blockbuster—the once uncontested dominant of the home movie and video game rental industry—was blindsided by Netflix despite the former's superior capabilities in managing the physical distribution process across an expansive network of brick-and-mortar stores. Blockbuster was so focused on perfecting its physical distribution operations that it failed to recognize the opportunities that the internet had to offer. Not only did it lack the strategic foresight to anticipate the internet's potential as an effective and efficient distribution platform, it blindly dismissed its adoption by the competition as a non-threat. Blockbuster's commitment to improving its physical-distribution model through operational excellence turned it myopic to Netflix's potential to trigger a market shift that would subsequently undermine its (i.e., Blockbuster's) value proposition. It underestimated the internet-based model and went so far as to decline, in 1999, an offer to take a 49% equity stake in Netflix in exchange for the latter using the domain name Blockbuster.com (The New York Times Conferences, 2015). This happened at a time when Blockbuster was a thousand times bigger than Netflix ($5 billion vs. $5 million in revenue). A decade and a half later, Blockbuster is out of business and Netflix is an $8.8 billion company by revenue, $72 billion by market capitalization.

Although not all operations-focused organizations are doomed to ultimately fall out favor as dramatically as Blockbuster did when markets shift, the risk that they see such an outcome is proposed to be positively related to the length of stability in the firms' product-market prior to the shift. The longer a firm's market remains stable, the more entrenched its operations orientation becomes and the weaker its ability to foresee and adapt to structural market shifts when they occur.

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V. Conclusion

This dissertation addressed the concept of operational excellence as it relates to firm performance in the short and long terms. Construed as the ultimate goal of operations management, operational excellence reflects a firm's ability to run its day-to-day operations efficiently, effectively, and profitably (e.g., Kaplan and Norton, 2008; Mentzer et al., 2008; Treacy and Wiersema, 1993). For a typical brick-and-mortar retailer, operational excellence would for example entail achieving high on-shelf availability without compromising inventory efficiency such that a high level of profitability is attained. For a manufacturer, operational excellence would encompass the same inventory efficiency, but instead of on-shelf availability, manufacturers would have factors such as conformance quality, production flexibility, and supply readiness as key ingredients of operational excellence (e.g., Rosenzweig and Easton, 2010).

Although one might expect operational excellence to be unanimously viewed as a positive achievement for any and all organizations, scholars and practitioners alike have had nuanced views on the competency's long-term value creation potential (e.g., Adler et al., 2009; Benner and Tushman, 2003; Kaplan and Norton, 2008). Diverging views have also been expressed as to how such excellence is achieved in the first place (e.g., Skinner, 1969; Clark, 1996; Ferdows and De Meyer, 1990). Do companies have to outperform on both efficiency and effectiveness simultaneously to achieve operational excellence, or should they focus on one or the other instead? This dissertation addressed these questions and contentious relationships in three separate essays.

Essay 1 examined the inner dynamics of operational excellence by looking at the individual and collective effects of efficiency and effectiveness on firm profitability. The goal was to assess the respective merits of two conflicting perspectives – the tradeoff and the cumulative perspectives – on whether firms can successfully improve efficiency and effectiveness simultaneously. Based on a large dataset of US public manufacturing firms, the empirical results revealed that most manufacturers experience positive returns on the simultaneous improvement of efficiency and effectiveness, indicating support for the cumulative perspective. This operational ambidexterity was found to have a compounding positive effect on firm profitability above and beyond what can be attributed to individual improvements to either efficiency or effectiveness in isolation. However, results also showed that the effect of operational ambidexterity can vary in magnitude and/or significance across industries, indicating the presence of idiosyncratic industry characteristics influencing the inner dynamics of operational excellence.

In essay 2, I revisited a key argument in the productivity dilemma literature suggesting that firms with a pronounced emphasis on operational excellence may do well in the short-term but may also undergo excessive routinization dynamics at the expense of strategic adaptability (e.g., Benner and Tushman, 2003). Drawing on signaling theory and using the stock market as gauge for the long-term value creation potential of operational excellence, essay 2 provided empirical evidence that the operational competency tends to be viewed by the investment community as a leading indicator of superior future shareholder value. Results also showed that the investment community's positive assessment is contingent on the community's own expectations of a firm's short-term revenue growth prospects and the firm's research and development efforts. Short-term revenue growth expectations are found to exert as a dampening force on the stock market's positive assessment of the long-term value creation potential of operational excellence whereas firm research and development was found to amplify the market's positive outlook.

In essay 3, I built on key arguments from the productivity dilemma literature to explore some strategic limitations to a firm's pursuit of operational excellence as a major source of competitive advantage. More specifically, I discussed how market stability can act as a double-edged sword that, on the one hand, provides an ideal environment for the effective leverage of operations management capabilities and associated operational excellence; and, on the other hand, causes firms to become overinvested in a narrow set of such capabilities at the expense of strategic foresight and market adaptation. I specifically discussed organizational learning dynamics that can explain why firms tend to gravitate towards operational excellence in periods of stability and how such a tendency may impair the firm's ability to anticipate or adapt to structural market shifts, with negative ramifications on firm long-term survival.

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