Firms can focus on increasing customer satisfaction and retention (revenue emphasis) and/or on decreasing costs (cost emphasis) when managing quality to achieve better business performance. Although previous research has shown the superiority of a revenue emphasis for maximizing the return on a company's quality efforts, research has not yet examined how a revenue emphasis is adopted in firms. This paper adopts a cognitive approach to strategy and examines managers' mental models— their belief systems—to understand that adoption process. Using a longitudinal, multi-level study, we surveyed managers at two points in time to collect information about their individual ("I believe…") and their divisions' collective ("We believe…") revenue and cost mental models for managing quality. Our research shows that the collective revenue emphasis converges toward the individual revenue emphasis over time, while the individual cost emphasis converges toward the collective cost emphasis. We show that this revenue emphasis convergence is related to improved business performance, but cost emphasis convergence is not.

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Keywords: Return on quality, Dual emphasis, Customer satisfaction, Quality management, Mental Models, Marketing strategy

1. Introduction

Doing things better can improve a firm's financial performance in various ways. On the one hand, doing things well can increase revenues. For example, a car that is better engineered might be more valuable to customers who are willing to pay a higher price. A skilled attorney can attract more clients and a user-friendly website can increase online orders. On the other hand, doing things better might also reduce costs. More precision and efficiency can produce the same output using fewer inputs while also reducing re-work and complaints. Doing things better or well is often referred to as quality, and it has been called the most important aspect of business strategy (Golder, Mitra, & Moorman, 2012). Companies focus on quality because they believe that it will improve their business performance.

The marketing literature provides evidence that increasing quality by satisfying customers more effectively can improve business performance by increasing revenues (Kamakura, Mittal, de Rosa, & Mazzon, 2002; Rust, Zahorik, & Keiningham, 1995). Literatures in such fields as operations and engineering similarly show that increasing quality by improving efficiency can improve business performance by reducing costs (Breyfogle, 2003), although too much emphasis on cost reduction can have a harmful effect on customer satisfaction (Bharadwaj & Roggeveen, 2008; Rust & Huang, 2012). These two approaches to quality are often viewed as opposites, in that the former looks outward toward customers and the latter looks inward toward the company's internal processes. In manufacturing, the two approaches are often in harmony, as better manufacturing processes produce better quality and lower costs. The marketing literature suggests that increasing quality can improve business performance by increasing revenues and reducing costs.
The performance implications of these changes. This may be thought of as involving organizational learning (March, 1991). A belief that quality should be managed to achieve customer satisfaction and retention (to reduce costs)

As summarized in Table 1, a management model of managing quality noted earlier, we derive four different types of quality mental models.

<table>
<thead>
<tr>
<th>Mental Model</th>
<th>Description</th>
<th>Revenue Emphasis</th>
<th>Cost Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual</td>
<td>Individual revenue mental model is a manager's belief that quality should be managed to achieve customer satisfaction and retention.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collective</td>
<td>Collective revenue mental model is an organization's belief that quality should be managed to achieve customer satisfaction and retention.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>Individual cost mental model is a manager's belief that quality should be managed to reduce costs.</td>
<td></td>
<td></td>
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<tr>
<td>Collective</td>
<td>Collective cost mental model is an organization's belief that quality should be managed to reduce costs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

goods at a lower cost through business process improvements (Deming, 1986). In service, however, the two approaches are often at odds, as satisfying customers better usually costs more (Anderson, Fornell, & Rust, 1997). With service becoming a larger part of every developed economy in the world, this increasingly implies a tradeoff.

Thus, quality has two paths, and managers must choose which of the two (or both) to follow. Consistent with these ideas, Rust, Moorman, and Dickson (2002) identify alternative strategic emphases firms can use in managing quality—a revenue emphasis, a cost emphasis, and a dual emphasis (which combines the revenue and cost emphases). In the revenue emphasis to managing quality, the firm increases quality in ways that are received and valued by the customer with the goals of greater customer acquisition, satisfaction, loyalty, and firm revenues as the means to higher profits. For example, United Airlines installed flat sleeper seats in most of its international business class cabins to improve the quality experienced by its most valuable customers.

In the cost emphasis to managing quality, the firm increases quality in ways that improve internal firm efficiency with the goal of reducing costs as the means to higher profits. For example, many companies replaced customer service call centers with automated phone systems that answer calls more cheaply. A cost emphasis, if successful, may also allow companies the option to lower prices, and hence increase unit sales, which might also increase revenues (e.g., Walmart's strategy). However, this is often a side benefit, as the primary focus is improvement of internal firm criteria, such as efficiency and productivity, not customer criteria.

The dual emphasis to managing quality tries to expand revenues and to reduce costs simultaneously. Rust et al. (2002) offer evidence that a revenue emphasis to managing quality produces the best business performance. Mittal, Anderson, Sayrak, and Tadikamalla (2005), by contrast, show that firms can achieve performance improvements if they implement a dual emphasis successfully over the long-term. However, as noted by Rust et al. (2002), very few firms are capable of doing both emphases well given the distinctive organizational systems, structure, and cultural underpinnings of the revenue and cost emphases.

Marketing appears to have embraced the idea that the customer should be central to most quality initiatives in companies. In their integrative framework, Golder et al. (2012) describe a set of quality processes, including quality production, quality experience, and quality evaluation that place the value of quality squarely at the customer-firm interface (see their Fig. 1). At the same time, this idea is not well understood in terms of how organizations achieve this perspective. In other words, our externally-facing view of quality is less well understood in terms of its organizational underpinnings. There are many ways to attack this problem as evidenced by the array of approaches taken to the study of marketing organizations in our literature. We adopt an approach from the cognitive approach to strategy that focuses on the belief systems or mental models within the organization (e.g., Daft & Weick, 1984; Day & Nedungadi, 1994; Frankwick, Ward, Hutt, & Reingen, 1994; Kaplan, 2008, 2011; Porac, Thomas, Wilson, Paton, & Kanfer, 1995; Rosa, Porac, Runser-Spanjol, & Saxton, 1999; Tripsas & Gavetti, 2000; Walsh, 1995; Weick, 1995).

From the perspective of this approach, the quality emphasis of an individual manager may be different from the organization’s quality emphasis. Consistent with this idea, we separate mental models residing at the individual manager level (“I believe...”) from those held at the collective level across managers (“We believe...”). Combining these two levels with the revenue and cost emphases to managing quality noted earlier, we derive four different types of quality mental models. As summarized in Table 1, a revenue (cost) mental model is a manager's belief that quality should be managed to achieve customer satisfaction and retention (to reduce costs) and a collective revenue (cost) mental model is an organization's belief that quality should be managed to achieve customer satisfaction and retention (to reduce costs).

We study how these mental models change as a firm adopts a revenue emphasis or cost emphasis to managing quality and the performance implications of these changes. This may be thought of as involving organizational learning (March, 1991). Following the call of Kozlowski and Chao (2012) to research convergence processes by using quantitative analysis in a dynamic framework, we address these research topics using a longitudinal, multi-level study of the adoption of quality mental models within companies. We survey managers at two points in time three years apart about their own individual and their business units' collective revenue and cost mental models. The three year time gap was selected to be long enough to ensure that real organizational change could occur, but short enough that many of the managers in the first-wave survey might still be on the job, and able to respond to the second-wave survey.

Over time the revenue (cost) emphases and collective revenue (cost) emphases may converge, indicating that the individual managers and the collective organization are aligning with respect to how quality should be managed. We show that this convergence tends to occur systematically along two key lines—the revenue emphasis converges toward the individual revenue emphasis and the individual cost emphasis converges toward the collective cost emphasis. Further, we show that this type of revenue emphasis convergence leads to better business performance, while cost emphasis convergence does not. These
results support the prior focus on the business performance benefits of a revenue emphasis to return on quality while offering an understanding of how mental model convergence plays a role in that outcome. 3

2. Individual and collective quality mental models

2.1. Two levels of mental models

While few would disagree with the notion that individuals have mental models (e.g., Johnson-Laird, 1983), the idea that organizations have knowledge outside the individuals comprising it or that individual and organizational knowledge are related is more controversial (see Moorman, 1995). Walsh and Ungson (1991) argue there are five retention bins where organizational memory is housed: (a) individual members; (b) organizational structures; (c) the firm’s standard operating procedures; (d) the firm’s culture; and (e) the firm’s physical structure. Four of these exceed the individual manager level and point to Durkheim’s, (1938, cited in Walsh, 1988, p. 15) observation that there are “collective ways of acting or thinking (that) have a reality outside of the individuals who, at every moment of time, conform to it.” This implies that a collective mental model is not simply the sum of individual mental models. Consistent with this view, research in marketing and strategy examining firm-level phenomena such as capabilities, resources, strategy, culture, and structure has focused on activities that exist beyond the individuals in the firm (Day, 1994; Deshpandé, Farley, & Webster, 1993; Homburg & Pfleffer, 2000).

Research in the cognitive approach to strategy has investigated how individual manager cognitions contribute to firm strategies and capabilities while at the same time managers are constrained and informed by these firm strategies and capabilities (e.g., Day & Nedungadi, 1994; Kaplan, 2011; Tripsas & Gavetti, 2000; Walsh, 1995; Weick, 1995). Research shows, for example, how firm capabilities are related to changes in managers’ cognitions (Laamanen & Wallin, 2009), how middle managers play roles as both interpreters and sellers of strategy change (Fiss & Zajac, 2006; Rouleau, 2005), and how the alignment of CEO cognition and organizational investments increase company product launches (Eggers & Kaplan, 2009). Our research fits into this tradition by first separating individual and collective mental models, showing how these mental models converge as they develop over time in firms, and examining how this convergence impacts firm performance.

2.2. How individual and collective mental models converge

Despite the identification of individual and collective mental models in organizations, how a firm’s mental models converge over time has received less attention. As noted by Spender and Grant (1996, p. 6), “The surge of interest into organizational capability and competencies has directed attention to organizational embedded knowledge, but has made only limited progress in understanding its anatomy and creation.” Likewise, there is a long tradition of research suggesting that firms can adopt new approaches to managing the market (e.g., Day, 1994; Kohli & Jaworski, 1990; Sinkula, 1994; Slater & Narver, 1995). However, there is very little empirical evidence pertaining to how this process is influenced by the relative impact of individual and collective sources of knowledge. This is an unfortunate gap given that insights about this process could offer guidance into the management of these activities as well as conceptual developments in this area.

We argue that there are two general ways in which mental model convergence might occur. First, collective belief systems drive individual manager thoughts and behaviors. In this view, organizational beliefs, goals, systems, routines, and structures socialize, inform, direct, and constrain managers to think and act in certain ways (e.g., Argote, 1999; Frankwick et al., 1994). We refer to this as collective-to-individual convergence because the mental model shifts from the organization to the manager.

Second, individuals can also drive what the organization thinks and knows (Cyert & March, 1963). As outlined in Grant’s (1996) model of organizational capabilities as knowledge integration and Crossan, Lane, and White’s (1999) 4I model of organizational learning, individual managers’ knowledge and interpretations can form that basis of institutionalized procedures and activities. This may occur when individuals come to a shared understanding of how to accomplish certain activities. As Grant (1996, p. 377) notes, “Integration of specialist knowledge to perform a discrete productive task is the essence of organizational capability.” Likewise, Crossan et al. (1999, p. 525) note that “Institutionalizing is the process of embedding learning that has occurred by individuals and groups into the organization, and it includes systems, structures, procedures, and strategies.” For example, research shows that individual manager choices, such as job creation, are often retained by organizations as policies (Miner, 1989). Also, individual goals can be transferred from work groups to the organization as a whole (Chadwick & Raver, 2015). In accordance with these views, research shows that bottom-up learning in fact can impact the organization’s strategy (Lee, Sting, & Loch, 2014). Fulmer and Ostroff (2015) provide a review of the research on how higher-level phenomena emerge from lower-level elements in organizations. We refer to this as individual-to-collective convergence because the mental model shifts from the manager to the organization.

We offer these ideas about process to inform the theoretical backdrop of the convergence predictions that follow, not as a guide to theory testing. Therefore, although we cannot test these process mechanisms, our observations about convergence conform to these ideas.

3 Although Rust et al. (2002) and Mittal et al. (2005) describe a dual emphasis to managing quality (which combines the revenue and cost approaches), the dual emphasis is not examined in our empirical study, given our theoretical focus. Specifically, given the patterns we predict, the dual emphasis should show no change over time. Future research that explores the dual emphasis in a similar manner would contribute further to the literature.

4 Researchers study both organizational culture and climate as manifested in belief systems (see Denison, 1996). Quality mental models, as a belief system that represents the focus of quality improvements, are likely to be influenced by culture and climate. For example, an organizational culture externally focused on customers makes a revenue emphasis more likely, whereas an organizational climate more focused on structured interpersonal processes makes a cost emphasis more likely. Despite these potential relationships, quality mental models, as belief systems focusing on quality efforts, should be viewed as a separate construct from culture or climate.
3. The nature and performance impact of quality mental model convergence

3.1. The nature of quality mental model convergence

We propose that a revenue emphasis to managing quality will occur via individual-to-collective convergence, meaning that the mental model moves from the individual to the collective level. Revenue originates with the customer, and the people closest to the customer are the contact people, “front-line” employees such as salespeople and customer service people, who in most organizations are lower-level people and not part of the top management team. These customer contact people are the members of the organization who have the strongest incentives to drive sales, revenue and customer retention (Hauser, Simester, & Wernerfelt, 1994). This should result in effort by the front-line to increase their managers’ emphasis on revenue. The closer a manager is to the front-line, the more aligned the manager’s incentives are likely to be with those of the front-line employees. This effect can be true even for higher-level managers. For example, the CEO and top management team typically feel imminent pressure to meet short-term earnings projections, which means they are unlikely to value customer-centered quality improvements as much, because those take time to be effective. Managers somewhat lower in the organization do not feel those pressures as severely, meaning that they will tend to place more emphasis on customer-centered quality improvements that drive revenue (revenue emphasis). Thus, the impetus for a revenue emphasis is likely to be bottom-up rather than top-down.

In addition, we offer three organizationally-based reasons for our prediction. First, research, in general, supports the idea that formalized structures are ineffective in facilitating the adoption of innovation in organizations (Zaltman, Duncan, & Holbek, 1973). Adapting a revenue emphasis to managing quality requires novel behaviors that involve understanding customer needs and how the company’s products and services may be changed to serve customer’s needs more effectively. Research confirms that formalized structures that require employees to abide by rules and regulations and to work through formal channels tend to reduce employee involvement and commitment in general (Homburg & Pflessier, 2000) and the acquisition and sharing of customer information in particular (Jaworski and Kohli, 1993). Instead, employees tend to be more motivated to learn about customer-related activities through informal communications and mentoring (e.g., Lam, Kraus, & Ahearne, 2010).

Second, literature suggests that mental models emphasizing a customer focus, such as a revenue emphasis to quality, require cross-functional cooperation in order to succeed (Ernst, Hoyer, & Rübsamen, 2010; Homburg & Pflessier, 2000; Kohli & Jaworski, 1990; Narver & Slater, 1990). This is because functions often have to collaborate to provide a good, service, or experience valued by the customer and profitable for the company. For example, in a quality context, it is important for R&D to understand how customer satisfaction is connected to product quality, for operations to manage the connection between customer satisfaction and the supply chain, and for finance and accounting to view satisfied customers as long-term assets that can be managed for financial payoffs. Unfortunately, research shows that most organizations have ineffective formal or informal cross-functional linkages and those that do exist are often contentious (Fisher, Maltz, & Jaworski, 1997). Worsening matters, business functions are often individual cost centers (Acemoglu, Aghion, Lelarge, Van Reenan, & Zilibotti, 2007) responsible for their own bottom-lines, which may further reduce motivation to seek cross-functional cooperation. Given these weak cross-functional linkages, the organization at large is not likely to be the instigator of a revenue emphasis to quality. Instead, a revenue emphasis to quality will likely have to emanate from individual managers who see the need for a customer focus and are willing to do the footwork to make it a reality throughout the organization.

Third, organizational incentive systems often involve bonuses based on short-term profits and firm performance (Frydman & Jenter, 2010), which are most easily achieved through cost controls, while tending to neglect the health of long-term marketing assets such as customer relationships (Srivastava, Shervani, & Fahey, 1998). Specifically, reward systems often focus on performance results achieved through short-term strategies that drive customers’ immediate transactions, not their relationships, with companies (Mela, Gupta, & Lehmann, 1997). Other research shows that these short-term rewards drive managers to focus on achieving a rosy bottom-line by cutting marketing and R&D expenditures (Mizik, 2010). This results in stronger short-term company performance, but weaker long-term company performance. These findings imply that without visionary employees thinking about quality from the customer’s point of view, the organization’s incentive system will, on average, put the focus back on managing costs.

Each of these three lines of thinking leads us to conclude that bringing a revenue emphasis to the larger organization will require change to come to the collective from enlightened and motivated individuals. Revenue comes from customers, so those closest to the customer know most about how to satisfy customers and increase sales, and must communicate to the rest of the company.

As discussed in Gebhardt, Carpenter, and Sherry (2006), these individuals will act as change agents within the organization. We predict:

H1. Over time, the collective revenue emphasis will converge toward the individual revenue emphasis.

---

3 Many studies find a correspondence between organizational-level factors, such as culture, structure, and processes, with a firm’s customer focus. These findings do not in any way negate our view that such an emphasis occurs through an individual-to-collective process. This is the case because prior research using cross-sectional data is unable to address the question of convergence.

6 Models of “trickle-down leadership” (Mayer, Kwanzi, Greenbaum, Barres, & Salvador, 2009) suggest that individual leaders can influence lower-level employees through their example behaviors in a form of social learning. These models support our argument that individuals can lead the overall organization toward the more customer-based revenue emphasis to managing quality. Trickle-down, in this case, remains an individual effect; however, the individual is in a position of authority, which should expedite the convergence process.
We now discuss the longitudinal multi-level survey method used to test our predictions. By contrast, we predict that a cost emphasis to quality may be more naturally built into the organizational structures and procedures of companies, leading to a convergence process that moves from the collective level to the individual level. First, organizations must comply with generally accepted and required approaches for managing costs and disclosures. This means there are well-established procedures and norms for capturing, communicating, and controlling costs. As a result, there is less need for individual managers to interpret or to help create such procedures. This is consistent with Nonaka’s (1994) views about the sharing of explicit or documented information in companies. By contrast, tacitly-held knowledge that arises from interacting with customers in the revenue emphasis would move from individuals to assume the form of organizational knowledge.

Second, given the explicit nature of knowledge and the existence of highly structured and deeply engrained managerial processes, approaches to quality that are based on efficiency and cost reduction can be yoked up fairly easily. Therefore, while quality improvement programs such as Six Sigma and Lean Six Sigma must be learned (Breyfogle, 2003; Deming, 1986), these adoption processes are facilitated by formalized organizational structures that require adherence to externally-validated procedures. Third, the same organizational incentive systems that emphasize short-term profits and drive out customer focus facilitate a focus on cost controls, thereby making an organizational cost emphasis easy to adopt at the individual manager level.

Given these arguments, a cost emphasis to managing quality should require change to come to the individual from the organization. As such, in the cost approach to quality, we expect the individual mental model to converge toward the collective mental model. We predict:

**H2.** Over time, the individual cost emphasis will converge toward the collective cost emphasis.

### 3.2. The performance impact of quality mental model convergence

We now consider how the convergence of individual and collective quality mental models impacts business unit performance. Following prior research, we expect that companies adopting a revenue emphasis to quality throughout the organization will achieve the most positive performance effects. While Rust et al. (2002) offer a detailed set of arguments for the importance of a revenue emphasis, the core idea lies in the fact that when customer-based criteria drive quality decisions and investments there is an increased likelihood of marketplace success. A cost emphasis to quality, on the other hand, may generate profits from more efficient procedures and/or more productive employees. However, a cost focus may also sometimes reduce the quality that is perceived by customers, which may negatively impact their acquisition and retention over time. Finally, a dual emphasis that tries to manage both revenue and cost emphases to quality is sound in theory, and good if it can be accomplished, but is difficult to implement in practice given that the different approaches may contradict or challenge one another. Given this logic and results by Rust et al. (2002) demonstrating that companies with a higher collective revenue emphasis to quality experience higher business performance, we expect, in general, that a revenue emphasis to managing return quality will generate the highest company performance.

However, exactly which mental model—collective or individual—will produce superior business unit performance follows from our predictions. Hypothesis 1 predicts that the collective revenue emphasis converges toward the individual revenue emphasis. If true, then an increase in the company's collective revenue emphasis will reflect this shift, while changes in a company's individual revenue emphasis will not. It follows, therefore, that if a company's revenue emphasis to quality has a positive effect on performance, then increases in a company's collective revenue emphasis should predict this performance effect. We therefore predict:

**H3.** Over time, increases in the collective revenue emphasis will result in improved business unit performance.

A cost emphasis, on the other hand, is hypothesized to arise from the individual cost emphasis converging with the collective cost emphasis. If true, an increase in company's individual cost emphasis will reflect this shift, while changes in a company's collective cost emphasis will not. Unlike the positive effect of a revenue emphasis to quality, we expect that a cost-focused approach to managing quality will not have a positive effect on company performance in the long run. This occurs because the focus on efficiency and productivity may compromise activities or attributes that customers value. While cutting cost shows immediately on the balance sheet, it may drive customers away, and damage long-term business performance (Rust & Huang, 2012). It follows, therefore, that if a company's cost emphasis to quality fails to have a positive impact on company performance, then increases in a company's individual cost emphasis should fail to have a positive performance effect. We therefore predict:

**H4.** Over time, increases in the individual cost emphasis will not result in improved business unit performance.

One of the benefits of creating contrasting predictions for the convergence and performance impact of revenue and cost emphasis is increased confidence that our findings are not driven by method or statistical artifacts that align with predicted processes. We now discuss the longitudinal multi-level survey method used to test our predictions.

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7 A cost emphasis may increase short-term profitability, but still hurt overall performance in the long-run by harming revenues, market share and customer retention.
4. Method

4.1. Sample and informants

Our sample utilizes the basic approach (and first wave of data) in Rust et al. (2002), but expands it in two critical ways. First, Rust, Moorman, and Dickson use only one time period of data collection while we use two periods in our study. Second, they use only collective measures of quality mental models. Consistent with our theory, we use both individual and collective measures of quality mental models.

It is only possible to study the implementation of quality systems in companies engaged in these activities. Hence, we used a sampling technique that allows us to identify all companies that were engaged in programs to improve the connection between quality and profitability. Our population was therefore every company we could identify, through connections at the Marketing Science Institute (MSI), employing such a program, some of which contained multiple business units. Firms in this set employed an average of 70,000 people and were from both the goods and service sectors. In total, 110 business units were contacted.

Given the need to identify companies using programs to improve the connection between quality and profitability, we used a snowball sampling approach. Each company was contacted and the study was discussed at a very abstract level—as a study of how quality affects profitability. If the contact acknowledged their company was involved in these activities and agreed to participate in our research, we utilized two different models of participation, each of which was employed about half the time.

1. The first model asked a contact to share manager names. This produced a sample of 185 managers in 75 business units from which we received responses from 69 managers representing 43 business units (37.3% response rate).
2. The second model asked the contact to mail the surveys to a sample of managers who have knowledge and experience in the quality profitability area. Contacts at 35 business units agreed to distribute 664 questionnaires to managers. In the end, eight business units did not participate, while contacts at 27 business units mailed 368 questionnaires inside their firms. Of these, 117 managers responded (31.8% response rate).

No differences were observed using data from the two sampling methods. The final sample was 186 managers from 70 business units. We observe the following features of these business units. First, companies are from a range of industries, including Technology (16%), Energy (18%), Financial (29%), Transportation (7%), Telecom (7%), Cleaning (4%), Intermediary/Recruitment (4%), Construction (4%), Fuel (4%), Consultancy (4%) and Catering Services (4%). Second, the average business unit size is 3230 employees (SD = 2710). Third, business units have an average number of years using return on quality systems of 5.96 years (SD = 4.87), report to have made moderate “investment of resources to learn to measure quality” (M = 3.72, SD = 1.21), and “investment of resources in linking quality efforts to financial performance” (M = 3.27, SD = 1.14), both measured on 7-point scales were 1 = low level and 7 = high level.

At the individual manager level, functional affiliations are Marketing (40%), Manufacturing/Operations (16%), R&D/Engineering (9%), Human Resources (8%), Accounting/Finance (5.4%), Quality Management (4%), Strategy (4%), Multiple Functions (4%), Product Management/Planning (3%), and missing (10%). We examined the extent to which respondents had sufficient knowledge and experience to serve as key informants for their organization (Campbell 1955). Our sample of managers spend an average of 9.6 hours per week making decisions about quality (SD = 5.00), have high levels of experience measuring financial performance (M = 5.21, SD = 1.44), rate their knowledge of how to measure return on quality as above average (M = 4.78, SD = 1.14), and self-report above average job performance (M = 5.23, SD = 0.93), all on a 7-point scale (see Appendix A for measure details).

To address the convergence processes associated with adopting a revenue or cost mental model and to assess the impact of convergence on business unit performance, it was necessary to collect information about individual and collective mental models at two points in time. Therefore, three years following the initial data collection, all 186 respondents were sent a follow-up questionnaire containing the mental model and business unit performance measures. The three-year gap was designed to minimize any bias that might have resulted from having previously been surveyed, to ensure that our findings are not a measurement artifact, and to allow time to let the quality convergence process unfold within the organization. Of the original sample of n = 186, 38 respondents had left the firm or died or the firm had gone out of business. This reduced the eligible sample to 148 managers. Of these, 74 managers from 43 business units responded to the second wave of surveys for a response rate of 50%. After cleaning the dataset to remove surveys with incomplete responses on the quality mental model and performance measures, we were left with a final sample of 67 managers from 40 business units.

Considering this procedure and sample, several observations are worth mentioning. First, no significant differences were found between time 1 and time 2 samples on the six time 1 performance indicators, indicating that selection bias is not a concern. We perform more rigorous tests to rule out any selection effects in our robustness checks. Second, we estimate all of our models on the sample of respondents that responded to both waves of the survey. This approach allows us to rule out that sample changes are the cause of our observed quality mental model changes or changes in business performance. Finally, the second survey wave corresponded with a mild recession. If the effect of the recession on quality emphasis were relevant to our results, we might expect no change in either revenue emphasis or an increase in both individual and collective cost emphases, neither of which is manifested in our data.
3. This table reports business unit-level statistics. Correlations: All variables are measured on a 7-point scale. Notes: The correlation between time 1 and time 2 business performance is moderate with reasonable variance: time 1 (M = 4.41, SD = 0.80) and time 2 (M = 4.95, SD = 0.72). Managers were asked to rate their division. In measuring the quality profitability emphases of individuals and the organization, we instructed respondents to focus on “initiatives to improve the quality of products and processes.” We adopted this approach because the companies in our sample sold both goods and services, and we thought this approach was broad enough to cover the full spectrum of their activities. Note that we did not define quality, because how it was operationalized and understood by managers could vary quite a bit, as our study hopes to demonstrate. If we had defined it from either a cost or revenue perspective, we may have diminished our ability to detect these emphases in our sample.

In accordance with these principles, we measured individual and collective levels using the following approaches. To capture the individual level, respondents were asked to rate “the degree to which you believe certain statements to be true about firm initiatives to improve quality.” For example, for the revenue mental model, respondents rated their individual agreement with “Quality improvements should be differentiated by their impact on customer satisfaction/retention” and for the cost mental model, respondents rated their individual agreement with “Quality improvements should be differentiated by their impact on cost savings” (see Appendix A for a complete set of measures).

To capture the collective level, respondents were asked the same questions as in the individual level, but were asked to rate “the degree to which the managers in your division agree with the following statements about initiatives to improve the quality of products and processes.” A strength of this approach is that it allows us to distinguish individual beliefs from collective beliefs because the manager can report what “I believe” relative to what the “organization believes.” Alternatively, it would be possible to use the average of the individual managers’ scores as the “collective” score. However, this measure reflects the average individual belief, which may differ from collectively-held beliefs. This concern is also expressed by Crossan et al. (1999, p. 529) who note, “Organizational learning is different from the simple sum of the learning of its members.” By asking managers to report on what people agree about, we tap into the manager’s sense of shared beliefs in the firm.

4.2.2. Business unit performance

In order to separate convergence from performance, business unit performance was also measured at both time 1 and time 2. Managers were asked to rate their business unit’s performance on market share, profits, and customer retention and relative to relative to competition and relative to firm goals. These two dimensions validated as a single measure in each time period as indicated by significant correlations between the two dimensions (time 1: \( \rho = 0.37, p < 0.01 \)) and (time 2: \( \rho = 0.77, p < 0.01 \)). Actual business unit performance was moderate with reasonable variance: time 1 (M = 4.41, SD = 0.80) and time 2 (M = 4.95, SD = 0.72). There were no missing values on any of the indicators in time 2 business unit performance. For time 1 business unit performance, any missing values on individual items were imputed by regressing the remaining indicators on the missing indicator (see Appendix B). The correlation between time 1 and time 2 business performance is \( \rho = 0.22 \) (\( p < 0.10 \)). The fact that this correlation is not higher is reflective of the flux that exists in most competitive industries (Shughan & Mitra, 2013).9

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Table 2

Descriptive statistics and intercorrelations.

<table>
<thead>
<tr>
<th>Measure</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
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<tbody>
<tr>
<td>1. Individual revenue mental model (t1)</td>
<td>5.73</td>
<td>0.69</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Individual revenue mental model (t2)</td>
<td>5.43</td>
<td>0.84</td>
<td>-0.38</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Individual revenue mental model (t2)</td>
<td>5.80</td>
<td>0.74</td>
<td>-0.22</td>
<td>-0.03</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4. Individual revenue mental model (t2)</td>
<td>5.81</td>
<td>0.66</td>
<td>0.31</td>
<td>0.33</td>
<td>0.39</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Individual revenue mental model (t1)</td>
<td>5.37</td>
<td>0.92</td>
<td>-0.11</td>
<td>-0.27</td>
<td>0.05</td>
<td>0.11</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>6. Individual revenue mental model (t2)</td>
<td>4.11</td>
<td>0.97</td>
<td>-0.16</td>
<td>-0.03</td>
<td>-0.27</td>
<td>-0.29</td>
<td>-0.34</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Individual revenue mental model (t2)</td>
<td>4.34</td>
<td>0.95</td>
<td>-0.11</td>
<td>-0.28</td>
<td>0.30</td>
<td>-0.28</td>
<td>-0.07</td>
<td>0.38</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Individual revenue mental model (t2)</td>
<td>4.32</td>
<td>1.02</td>
<td>-0.14</td>
<td>-0.36</td>
<td>0.13</td>
<td>-0.31</td>
<td>-0.09</td>
<td>0.31</td>
<td>0.72</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Business unit performance (t1)</td>
<td>4.41</td>
<td>0.80</td>
<td>0.02</td>
<td>0.22</td>
<td>0.23</td>
<td>-0.11</td>
<td>0.08</td>
<td>-0.14</td>
<td>-0.10</td>
<td>0.10</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10. Business unit performance (t2)</td>
<td>4.95</td>
<td>0.72</td>
<td>0.03</td>
<td>0.11</td>
<td>0.12</td>
<td>0.13</td>
<td>-0.00</td>
<td>0.10</td>
<td>-0.06</td>
<td>0.15</td>
<td>0.22</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes:
1. All variables are measured on a 7-point scale.
2. Correlations: \( \rho > 0.31 \), \( p < 0.05 \).
3. This table reports business unit-level statistics (\( n = 40 \)).

4.2. Measures

Appendix A contains all study measures, Appendix B describes all measure validation procedures, and Table 2 contains a correlation matrix and descriptive statistics for the measures in our estimated models.

4.2.1. Individual and collective quality mental models

To reduce measurement error, we developed measures of individual and collective revenue and cost quality mental models using similar content and parallel construction. Identical measures were used at time 1 and time 2. However, as we describe in detail below, we shift the informant’s attention from their own individual beliefs to the collectively-held beliefs of managers in their division. In measuring the quality profitability emphases of individuals and the organization, we instructed respondents to focus on “initiatives to improve the quality of products and processes.” We adopted this approach because the companies in our sample sold both goods and services, and we thought this approach was broad enough to cover the full spectrum of their activities. Note that we did not define quality, because how it was operationalized and understood by managers could vary quite a bit, as our study hopes to demonstrate. If we had defined it from either a cost or revenue perspective, we may have diminished our ability to detect these emphases in our sample.

In accordance with these principles, we measured individual and collective levels using the following approaches. To capture the individual level, respondents were asked to rate “the degree to which you believe certain statements to be true about firm initiatives to improve quality.” For example, for the revenue mental model, respondents rated their individual agreement with “Quality improvements should be differentiated by their impact on customer satisfaction/retention” and for the cost mental model, respondents rated their individual agreement with “Quality improvements should be differentiated by their impact on cost savings” (see Appendix A for a complete set of measures).

To capture the collective level, respondents were asked the same questions as in the individual level, but were asked to rate “the degree to which the managers in your division agree with the following statements about initiatives to improve the quality of products and processes.” A strength of this approach is that it allows us to distinguish individual beliefs from collective beliefs because the manager can report what “I believe” relative to what the “organization believes.” Alternatively, it would be possible to use the average of the individual managers’ scores as the “collective” score. However, this measure reflects the average individual belief, which may differ from collectively-held beliefs. This concern is also expressed by Crossan et al. (1999, p. 529) who note, “Organizational learning is different from the simple sum of the learning of its members.” By asking managers to report on what people agree about, we tap into the manager’s sense of shared beliefs in the firm.

4.2.2. Business unit performance

In order to separate convergence from performance, business unit performance was also measured at both time 1 and time 2. Managers were asked to rate their business unit’s performance on market share, profits, and customer retention and relative to relative to competition and relative to firm goals. These two dimensions validated as a single measure in each time period as indicated by significant correlations between the two dimensions (time 1: \( \rho = 0.37, p < 0.01 \)) and (time 2: \( \rho = 0.77, p < 0.01 \)). Actual business unit performance was moderate with reasonable variance: time 1 (M = 4.41, SD = 0.80) and time 2 (M = 4.95, SD = 0.72). There were no missing values on any of the indicators in time 2 business unit performance. For time 1 business unit performance, any missing values on individual items were imputed by regressing the remaining indicators on the missing indicator (see Appendix B). The correlation between time 1 and time 2 business performance is \( \rho = 0.22 \) (\( p < 0.10 \)). The fact that this correlation is not higher is reflective of the flux that exists in most competitive industries (Shughan & Mitra, 2013).9
Our performance measure relies on managers’ perceptions rather than on objective outcomes. This approach was used for three reasons. First, research has suggested that managers’ perceptions are accurate and consistent with objective measures of performance (Dess & Robinson, 1984). Second, objective performance is generally reported at the overall-firm level, while our unit of analysis is the business unit. Collecting secondary data about business unit performance was not feasible. Third, we do not have a measure of the firm’s strategy or goals, both of which may influence its performance. Finally, in a multi-industry context, such perceptual measures (when rated relative to expectations or relative to competition) offer some measure of control for industry-specific fixed effects that would otherwise contaminate the analysis. For example, if Company A is in a fast-growing or profitable industry and Company B is not, then objective performance measures would tend to favor Company A, even if that company was a poor performer compared to its competition.

4.3. Models and estimation

4.3.1. The convergence of quality mental models

Hypothesis 1 predicts that revenue mental model convergence proceeds from an individual level to a collective level, whereas Hypothesis 2 predicts that cost mental model convergence proceeds from a collective level to an individual level. These hypotheses were tested with regression Eqs. (1–4) below. The difference of the mental model levels between time 2 and time 1 is modeled for each of the four mental models: individual revenue, collective revenue, individual cost, and collective cost (these equations are at the business unit level, \( j \). However, for simplicity of exposition, we suppress the \( j \) subscript). We estimated the following models:

\[
\begin{align*}
BCR_{t2} &= BCR_{t1} + \gamma_1(BIR_{t1} - BCR_{t1}) + \varepsilon_1 \\
BIR_{t2} &= BIR_{t1} + \gamma_2(BCR_{t1} - BIR_{t1}) + \varepsilon_2 \\
BIC_{t2} &= BIC_{t1} + \gamma_3(BCC_{t1} - BIC_{t1}) + \varepsilon_3 \\
BCC_{t2} &= BCC_{t1} + \gamma_4(BIC_{t1} - BCC_{t1}) + \varepsilon_4
\end{align*}
\]

where \( BCR \) is the business unit’s collective revenue (mental model) emphasis, \( BIR \) is individual revenue emphasis, \( BIC \) is individual cost emphasis, \( BCC \) is collective cost emphasis, \( t_1 \) and \( t_2 \) refer to time period 1 and time period 2 respectively, and the \( \varepsilon \)'s are random normal error terms.

Eq. (1) provides a direct test of H1—whether the collective revenue emphasis converges toward the individual revenue emphasis. Likewise, Eq. (3) provides a direct test of H2—whether the individual cost emphasis converges toward the collective cost emphasis. Eqs. (2) and (4) are included for completeness, to test whether any unhypothesized convergence occurs (individual revenue emphasis toward the collective revenue emphasis, or collective cost emphasis toward the individual cost emphasis).

Eq. 1 tests whether the dependent variable mental model (e.g., \( BCR_{t2} \)) moves toward the other mental model (e.g., \( BIR_{t1} \)). For example, if the collective revenue emphasis converges all the way toward the individual revenue emphasis, \( \gamma_1 \) will be equal to one. If the collective revenue emphasis does not converge at all toward the individual revenue emphasis, \( \gamma_1 \) will equal zero. Therefore, the statistical test for \( \gamma \) examines whether the independent variable mental model moves toward (a significant negative \( \gamma \)), away (a significant positive \( \gamma \)), or is unrelated to the dependent mental model (not significant). We also note that the difference formulation implied by the equations controls for any unobserved heterogeneity related to business unit. As we hypothesize a convergence process over time, we only use time 1 mental models to predict time 2 mental models.

Because the observed data are at the individual level and not the business unit level, this is appropriately modeled as a multi-level (hierarchical) model. Thus we assume that the individual data within business unit are errorful measures of the true business unit construct. Capturing this multi-level and multi-period model with canned multi-level statistical software is difficult, if not impossible. To address these modeling complexities, we employ a Bayesian model that examines mental model convergence and financial performance all in the same equation. Modeling all of the equations as a system is preferred, because estimating them in a piecemeal manner can result in inconsistent estimates for the parameters (Greene, 1993, p. 710). Details of the model estimation are given in Appendix C.

4.3.2. The performance impact of quality mental model shifts

Each business unit is assumed to have a true business performance, \( PERF_j \) at time 1 and time 2, respectively. Again we have individual respondent measures of these constructs in a multi-level formulation (see Appendix C). Hypothesis 3 predicts

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10 Eq. (1) through (4) model the difference between time 1 and time 2, as can easily be seen by subtracting the first right hand term from both sides. We present it this way to be consistent with how it is actually modeled in our Bayesian estimation using WinBUGS.

11 For the individual mental model items, the error may be interpreted as reflecting heterogeneity across the business unit’s managers. For the collective mental model items, the error may be interpreted as error of perception.
that increases in the collective revenue emphasis will result in improved business performance. Hypothesis 4 predicts that increases in individual cost emphasis will not result in improved business performance. These hypotheses are tested by the following equation:

$$\Delta \text{PERF} = \beta_1 \Delta \text{BCR} + \beta_2 \Delta \text{BIC} + \epsilon$$

(5)

The coefficient $\beta_1$ tests the impact of increases in collective revenue emphasis on change in business performance (testing Hypothesis 3) and $\beta_2$ tests the impact of increases in individual cost emphasis on change in business performance (testing Hypothesis 4). Because business performance is measured, in part, relative to other firms, across all firms the average improvement will, by definition, be zero, implying that the intercept term should be suppressed.12

5. Results

5.1. The convergence of quality mental models

According to H1, the revenue mental model converges from individual to collective. This implies that $\gamma$ should be positive and significant in Eq. (1), but not Eq. (2). In contrast, according to H2, the cost mental model converges from collective to individual, implying that $\chi$ should be positive and significant in Eq. (3), but not Eq. (4). Results from model testing these predictions are in Table 3. The table shows the mean $\gamma$ for each equation, the bounds of the 95% Bayesian credible interval (analogous to a confidence interval), and the resulting significance (viewed as significant if the credible interval does not include zero).

The convergence of the collective revenue emphasis toward the individual revenue emphasis in Eq. (1) is positive and significant ($\gamma_1 = 0.812, p < 0.05$). The convergence of the individual cost emphasis toward the collective cost emphasis in Eq. (2) is insignificant ($\gamma_2 = 0.086, ns$). These results support H1.

On the other hand, the convergence of the individual cost emphasis toward the collective cost emphasis in Eq. (3) is positive and significant ($\gamma_3 = 0.840, p < 0.05$), whereas the convergence of collective cost to individual cost in Eq. (4) is insignificant ($\gamma_4 = 0.094, ns$).13 These results support H2.

5.2. The performance impact of quality mental model convergence

Does the convergence of these mental models actually result in better business unit performance as predicted? To get an initial idea of this effect, we calculated the average mental model shifts by business unit and then sorted the business units into quartiles. We then measured the average business performance change, scaled as average change on a seven-point scale, again calculating the average for the business unit across all respondents within the business unit. Fig. 1 shows the business performance change associated with each quartile of change in collective revenue emphasis. It is clear from Fig. 1 that the lowest two quartiles resulted in very little business performance change, while the highest two quartiles resulted in much larger business performance change.14 Fig. 2 examines the impact of individual cost emphasis changes on business performance. As expected, in this case, there is no clear pattern.

To examine the effects of the mental model shifts more rigorously, we estimate the regression model in Eq. (5). This equation is estimated simultaneously with mental model convergence using the Bayesian estimation detailed in Appendix C. Results shown in Table 4 indicate that the coefficient relating change in collective revenue emphasis to change in business performance is positive and significant ($\beta_1 = 0.594, p < 0.05$), supporting H3, and that the coefficient relating change in individual cost emphasis on change in business performance is not significant ($\beta_2 = 0.099, ns$), consistent with H4.

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12 The appropriateness of this formulation is reinforced by the fact that including an intercept leads to a more unstable estimation and increased difficulties with model convergence, although the general pattern of results (while weaker) is similar.

13 One potential concern with using repeated mental model measures is that any observed increase in the levels from time 1 to time 2 results from repeated questions, which in many cases may increase the similarity of the responses in time 2 even if there are no true changes in mental models. However given that our measures were taken three years apart, we find it unlikely that memory effects play any role in our results.

14 A t-test comparing quartiles 1 + 2 with quartiles 3 + 4 confirms the existence of a significant difference in business performance change.
5.3. Robustness checks

One limitation of our current results is that we lose business units due to the two waves of the survey. This means that we have to be concerned about whether the firms that dropped out were different from those that remained in the sample. This is a problem if remaining firms experience convergence, whereas dropped-out firms do not. To answer this, we performed a Heckman two-stage test (Heckman 1979) of our models that includes a first stage predicting time 2 participation (0,1). This produced an Inverse Mills Ratio that accounts for selection into both waves of the survey, which we include in tests of Eqs. 1, 3 and 5. Eqs. 2 and 4 are excluded because we do not hypothesize convergence. Results provide no evidence of selection bias, as the Inverse Mills Ratio is not significant for the stage 1 test for Eqs. (1) and (5). It is moderately significant in Eq. (3). We examine stage 2 accounting for the Inverse Mills in all three models and find that the results exhibit little change.

A second challenge to our results is that they can be explained by functional differences among managers responding to the survey. To examine this question, we performed several tests. First, we compared differences in individual revenue, individual cost, collective revenue, and collective cost in each time period between marketers and non-marketers. Of these eight comparisons, only one was significantly different between marketers and non-marketers, individual cost emphasis at time 1 (Mean_{marketers} = 3.27 vs. Mean_{non-marketers} = 3.88, t(177) = 3.77, p < 0.05). This difference disappears at time 2. Second, we re-estimated our

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15 We do not introduce this selection test into our Bayesian model. Instead, we perform a test of the selection bias using Stata’s Heckman procedure. Details of this test are available from the authors upon request.
predicted models at the individual manager level (not business unit) and included an interaction between our hypothesized predictors and the dummy variable marketer (= 1), else (= 0). Results indicate that this interaction is not significant in any of our predicted models, suggesting that our results are not influenced by functional orientation. Finally, considering these functional differences at the business unit level, we focus on the function of the majority of reporting managers and code the business unit as marketing or non-marketing. Replicating the individual-level analysis using interactions, we observe no significant interactions in any of our models.16

6. Discussion

6.1. Theoretical implications

Research has tended to take two points of view in studying these belief systems (see Kaplan, 2011 for an excellent review). On the one hand, empirical work across strategy and marketing has tended to focus on how individual cognitions help create a new strategic focus or new capabilities for the firm (e.g., Day & Nedungadi, 1994). On the other hand, there also is research that ignores the role of individual managers and assumes the paramount role of firm strategy, capabilities, and culture (e.g., Kohli & Jaworski, 1990; Moorman, 1995; Narver & Slater, 1990).

Our work extends this literature in several ways. First, our results indicate that the way in which individual and organizational factors influence one another to create change in companies depends on the actual content of the information being transmitted. Specifically, we find that the collective revenue emphasis converges toward the individual revenue emphasis, suggesting that a revenue mental model converges from the individual-to-the-collective, whereas the individual cost emphasis converges toward the collective cost emphasis, suggesting that a cost mental model develops from the collective-to-the-individual. This initial evidence offers the field an opportunity to distinguish different change processes that operate when different types of mental models are transferred. This is the first study of which we are aware that theorizes about and demonstrates the existence of different types of convergence underlying the evolution of different types of mental models in organizations.

Second, our finding that collective revenue mental models move toward individual revenue mental models extends past research which has either inferred this movement by demonstrating that firm actions have changed (e.g., Eggers & Kaplan, 2009) or has focused on a single firm in which a new system was successfully implemented (e.g., Houston, Walker, Hutt, & Reingen, 2001). In both cases, the change in collective beliefs is not documented. Our study disentangles the individual and collective levels of these belief systems and shows how these mental models develop over time. Given we measure individual and collective beliefs at two points in time, we offer a rare assessment of this change process. Strategy research examining the hegemony of collective beliefs has tended to shy away from directly measuring these effects (Kaplan, 2011), whereas research in marketing has often focused on the evolution of individual beliefs without actually measuring the impact on the firm’s collective beliefs (e.g., Frankwick et al., 1994).

6.2. Managerial implications

Previous research has demonstrated that a revenue emphasis to quality results in strong business performance (Rust et al., 2002). Exactly how a firm should implement its quality efforts has not been previously explored. By considering mental models within the firm, we find preliminary evidence that a revenue mental model might best be implemented by starting with individual mental models and then letting the collective mental model converge with the individual mental models over time. We speculate that one of the reasons for this is that a revenue emphasis requires closeness to the customer, which means that individuals close to the customer must be the primary revenue mental model evangelists. This implies that a successful revenue approach to managing quality requires the introduction and management of new beliefs and procedures into the company. This shift to a collective revenue mental model through individual revenue mental models takes time to accumulate and to complete convergence.

Our empirical results conclude that convergence of the collective revenue mental model to the individual revenue mental model improves financial results. This suggests that firms may benefit from facilitating this convergence. Encouraging bottom-up communication through formal and informal mechanisms may speed up the utilization of this type of learning and make the firm more responsive to the market and the customer base, resulting in improved financial results.

If we accept this interpretation of our findings, firms may be advised not to try to implement a revenue emphasis by imposing rigid procedures or sweeping organizational changes in a top-down manner. Instead, they may be better advised to implement a revenue emphasis by educating and training individuals, who can, in turn, create procedures and policies that produce a collective

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16 We also tested marketing and R&D vs. other managers using these same tests and observe no significant interactions involving our predictors at the individual or business unit levels.
ment of opinions explicitly, we lacked the manager-specific information necessary to estimate the heterogeneity of influence. Future research may consider unique aspects of the evolutionary process as expressed in these two different types of companies, although advances in information technology increasingly blur the goods vs. services distinction (Rust & Huang, 2014).

Finally, it is possible that convergence of the revenue mental models may be affected by individual differences between the managers involved, both in terms of heterogeneity of influence and heterogeneity of opinions. Although we did model heterogeneity of opinions explicitly, we lacked the manager-specific information necessary to estimate the heterogeneity of influence. Future work that digs deeper into the variables that affect a manager's ability to produce effective convergence would be useful.

We see a number of other future research opportunities related to our work. First, research is necessary to pin down the specific process mechanisms by which these convergence activities take place. Although we discuss the movement of information through these convergence processes, our paper does not test the flow of knowledge between these different levels of the
organization. Doing so and offering a more detailed and nuanced understanding of this process is an important step for future research. Consideration of the effect of changes in leadership and other human capital explanations may also prove interesting. Second and related, it would be interesting to understand what is actually happening during the convergence process. How do individual change agents inform, persuade, or cajole others into new viewpoints? Studying this “internal selling process” (Hauser, Simester, & Wernerfelt, 1996) or these “corridors of influence” (Hartline et al., 2000) could extend the literature in important ways.

Third, a complementary study of how social networks help or hurt the adoption of quality mental models could answer several questions. For example, do social networks help the individual-to-collective convergence we observe in the adoption of revenue mental models because the networks facilitate the movement of individual change agent knowledge? Following Houston et al. (2001), we think it is likely that social networks will facilitate convergence when the inputs come from individuals and then social dynamics educate and motivate these individuals to move toward a collective view. Social networks may, in turn, be less important when a collective view is disseminated to individuals.

7. Conclusions

Our paper takes an important step in the direction of addressing the nature, convergence, and impact of quality mental models in organizations. Results of a longitudinal, multi-level study indicate that individual manager and collective mental models are distinct, as are mental models emphasizing costs and revenue approaches to managing quality. Our findings indicate that these mental models converge over time in unique ways—individual-to-collective convergence for revenue mental models and collective-to-individual convergence for cost mental models. Importantly, we observe that the individual-to-collective revenue convergence is significantly associated with improvement in business performance, while an individual cost emphasis shift is not.

Acknowledgement

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Appendix A. Measures and items

**Individual revenue mental model** \((t1, t2)\)

\[(CR_{t1} = 0.94, AVE_{t1} = 0.85, \alpha = 0.67) \quad CR_{t2} = 0.95, AVE_{t2} = 0.87, \alpha = 0.78)\]

*Rate the degree to which you believe the following statements to be true about initiatives to improve the quality of products and processes.*

1. The purpose of quality improvements is to improve customer satisfaction/retention.
2. Quality improvements should be differentiated by their impact on customer satisfaction/retention.
3. It is best to invest in improving those initiatives that greatly increase customer satisfaction/retention.

**Collective revenue mental model** \((t1, t2)\) (Rust, Moorman, and Dickson 2002)

\[(CR_{t1} = 0.97, AVE_{t1} = 0.92, \alpha = 0.79) \quad CR_{t2} = 0.95, AVE_{t2} = 0.87, \alpha = 0.75)\]

*Rate the degree to which the managers in your division agree with the following statements about initiatives to improve the quality of products and processes.*

1. The purpose of quality improvements is to improve customer satisfaction/retention.
2. Quality improvements should be differentiated by their impact on customer satisfaction/retention.
3. It is best to invest in improving those initiatives that greatly increase customer satisfaction/retention.

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17 T1 measures were collected in the first survey and t2 measures were collected three years later. A 7-point Likert scale ranging from “Strongly Disagree” to “Strongly Agree” was used unless otherwise indicated.
**Individual cost mental model** \( (t_1, t_2) \)

\[
(CR_{t1} = 0.86, AVE_{t1} = 0.67, \alpha = 0.74) \quad (CR_{t2} = 0.97, AVE_{t2} = 0.92, \alpha = 0.83)
\]

Rate the degree to which you believe the following statements to be true about initiatives to improve the quality of products and processes.
1. The purpose of quality improvements is to reduce costs.
2. Quality improvements should be differentiated by their degree of cost savings.
3. It is best to invest in improving those initiatives that greatly decrease costs.

**Collective cost mental model** \( (t_1, t_2) \) \cite{Rust2002}

\[
(CR_{t1} = 0.97, AVE_{t1} = 0.92, \alpha = 0.80) \quad (CR_{t2} = 0.97, AVE_{t2} = 0.91, \alpha = 0.83)
\]

Rate the degree to which the managers in your division agree with the following statements about initiatives to improve the quality of products and processes.
1. The purpose of quality improvements is to reduce costs.
2. Quality improvements should be differentiated by their degree of cost savings.
3. It is best to invest in improving those initiatives that greatly decrease costs.

**Business unit performance** \( (t_1, t_2) \) \cite{Moorman1999}

\[
(1 = \text{Worse}, 4 = \text{On par}, 7 = \text{Better})
\]

\[
(CR_{t1} = 0.97, AVE_{t1} = 0.86, \alpha = 0.80) \quad (CR_{t2} = 0.94, AVE_{t2} = 0.73, \alpha = 0.81)
\]

Relative to your division’s stated objective, how is your division performing on:
1. Profitability
2. Market share
3. Customer retention

Relative to your competition, how is your division performing on:
1. Profitability
2. Market share
3. Customer retention

**Key informant indicators**

**Quality knowledge** \( (t_1) \)

Write in the number of hours per week you are involved in making decisions regarding information that links quality initiatives to financial outcomes.

*Experience measuring financial performance* \( (t_1) \) \( (1 = \text{Low}, 4 = \text{Moderate}, 7 = \text{High}) \)

Rate your experience measuring financial performance.

*Job performance* \( (t_1) \) \( (1 = \text{Strongly Disagree}, 4 = \text{Uncertain}, 7 = \text{Strongly Agree}) \)

1. I have generally performed better than my peers in comparable jobs.
2. I am more effective in my job than my peers.
3. I have been promoted at faster rates than my peers.

**Appendix B. Measure validation procedures**

A confirmatory factor analysis is estimated including all time 1 and time 2 multi-item constructs measured for each individual. Indices indicate a reasonable model fit \( (\chi^2_{(522)} = 802.50, p < 0.01, \text{RMSEA} = 0.054, \text{SRMR} = 0.101, \text{TLI} = 0.82, \text{CFI} = 0.85) \). We do not observe excellent fits because we trade off some of this precision given our goal of using common measures across time.
and across quality emphases (see items in Appendix A). Construct reliabilities range from 0.86 to 0.97 indicating convergent validity. Average variances extracted range from 0.67 to 0.92 (see Appendix A for reliabilities and average variances for all multi-item measures). Average variance extracted for the CFAs also exceed squared construct correlations, indicating discriminant validity (Fornell & Larcker, 1981). This implies that individual and collective revenue and cost mental models are distinct constructs.

We also check for measurement invariance across time to make sure the measures of time 1 and time 2 revenue and cost mental models as well as firm performance are equivalent. Tests for configural and metric invariance are conducted because we are interested in predicting relationships and expect means to be non-equivalent over time due to learning (Vandenberg & Lance, 2000). All factor loadings are significant and substantially different from zero, indicating that configural invariance is achieved. In addition, the model shows an adequate fit, permitting inspection of metric invariance. By constraining factor loadings across time we check metric invariance, which achieves a comparable fit ($\chi^2(535) = 827.84$, $p < 0.01$, RMSEA = 0.054, SRMR = 0.109, TLI = 0.82, CFI = 0.84). However, the chi-square test shows that configural and full metric measurement models are not comparable in fit ($\Delta\chi^2(13) = 25.34, p < 0.05$). Thus, we check for partial metric invariance by freeing one item over time, which has different loadings across time. This model is comparable to the configural measurement model ($\Delta\chi^2(11) = 10.77, ns$), therefore partial metric invariance is achieved and we can conclude that mental model and performance measures are equivalent over time (Vandenberg & Lance, 2000).

Appendix C. Bayesian model and estimation

The Bayesian model estimates the mental model shifts and the financial performance in one comprehensive modeling framework and estimation. The estimation is complicated by the fact that we are working with both multi-level data and shifts over time, which makes the use of canned multi-level statistical software infeasible.

The model assumes that all of the individual observations result from the actual business unit value, but are observed with error (which may be interpreted as error in perception, for the collective variables, or heterogeneity of perception, for the individual variables). Thus, if $B_{kj}$ is the true business unit value of any particular variable $k$ for business unit $j$, and $i_{jk}$ is respondent $i$’s response on that variable, we assume that $i$’s response is drawn from a normal distribution according to:

$$i_{jk} \sim \text{Normal}(B_{jk}, \tau_k)$$

where $B_{jk}$ is the mean, and $\tau_k$ is the precision (inverse of the variance), with $\tau_k$ drawn from a gamma distribution with parameters (.01, .01).

We model the mental model shifts at the business unit level, with latent constructs for both the individual variables and the collective variables. For example, to test whether the collective revenue emphasis is drawn toward (attracted to) the individual revenue emphasis, we model that as:

$$BCR2_j \sim \text{Normal}(\arg, \tau_{BCR2})$$

with $\tau_{BCR2}$ drawn, as before, from a gamma distribution with parameters (.01, .01), and the mean being:

$$\arg = BCR_j + \gamma(BIR_j - BCR_j)$$

In this formulation the second-period business unit variables are generated from the variable values in the first period. The first period business unit variables are drawn from a diffuse prior (a normal distribution with mean 4 and precision 0.2). (This may appear to not be as diffuse as the usual diffuse normal prior, but in this case we know the range of the data are restricted to the (1,7) interval, which means that the prior we use is diffuse enough to cover the interval without unduly restricting the parameter.) Also we draw the $\gamma$ s from a normal distribution with mean 0.5 and precision 0.4. Again we use our knowledge of the range of the data to provide a tighter prior for $\gamma$ than would otherwise be appropriate.

We estimated the combined model with Markov Chain Monte Carlo (MCMC) methods, using WinBUGS (Lunn, Thomas, Best, & Spiegelhalter, 2000). After a burn-in period of 400,000 draws, inspection of the hyperparameter plots and examination of standard errors indicated that the model had converged. We then used the subsequent 20,000 draws to obtain the model results that are reported in the table.

References


Fornell, Claes; and Larcker, David F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(February), 39–50.


