



Managing contract manufacturer quality in the presence of performance ambiguity



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ABSTRACT

Brand-owning firms have been outsourcing the production of complete finished products to contract manufacturers (CMs) for some time. Increasingly, brand-owning firms have been employing CMs to produce products for which performance ambiguity is high. Doing so poses challenges for the management of CM performance. As expected, we find that quality performance ambiguity has a significant negative relationship with CM conformance quality performance, as reported by the buyers (the brand-owning firms). Drawing from and expanding the quality management (QM) literature, we assess the effectiveness of key constructs, derived primarily from the “supplier QM” meta-construct, at mitigating the detrimental effect of ambiguity. Two constructs consistently moderate the ambiguity-CM quality performance link. Heavily emphasizing quality at the time of CM selection moderates this relationship in the expected direction (*i.e.*, it mitigates the challenges created by ambiguity). Surprisingly, we find that using one CM amplifies the negative relationship between ambiguity and conformance quality performance. One possible explanation is that employing only one CM aggravates existing opportunism concerns with regard to conformance quality performance under high levels of ambiguity.

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1. Introduction

Outsourcing part, component, and material production is a well-established practice in operations and supply chain management (Hayes et al., 2005). Outsourcing the production of complete finished products to contract manufacturers (CMs) has intensified since the 1990s in the electronics, pharmaceutical, automotive, and food/beverage industries, among others (Brewer et al., 2013; Plambeck and Taylor, 2005; Tully, 1994). Finished products outsourced to CMs are not shipped back to the buyer, typically a brand-owning firm, for further processing (Arruñada and Vázquez, 2006). Unlike outsourcing parts or materials, buyers face heightened outgoing product quality risks with CMs, having less opportunity to detect CM-generated defects before finished products hit the market. Compounding this risk, some firms outsource products with high levels of performance ambiguity, which Stump and Heide (1996; p. 436) define as “the inherent difficulty faced by the buyer in accurately evaluating the supplier’s

performance.”¹ Building on this, we define quality performance ambiguity as situations in which firms are outsourcing production where it is difficult to: (1) ensure process and product specification conformance through finished-product testing [low testability], (2) ensure process requirement conformance through direct observation [low monitorability], and/or (3) determine whether an external failure is attributable to the buyer or CM [low root-cause assignability]. As we elaborate in the next section, these dimensions are derived from the organizational control literature (*e.g.*, Eisenhardt, 1985) and the largely analytical literature on incentivizing CMs and suppliers to improve quality performance (*e.g.*, Baiman et al., 2001); both of these literature streams draw from the measurement perspective from the theory of the firm literature (*e.g.*, Alchian and Demsetz, 1972). This study contributes to the supply chain quality management (QM) literature by examining how quality performance ambiguity directly influences CM conformance qual-

¹ We note there is a concept called “causal ambiguity” (Lippman and Rumelt, 1982; King and Zeithaml, 2001; Powell et al., 2006) in the strategy literature specifically focused on how firms achieve sustainable competitive advantage. There, the term refers to ambiguity in the path to achieving certain capabilities, ultimately serving as a barrier to imitation. While the underlying meaning – the inability to tie performance outcomes to specific causes – is closely related, our construct is more narrow.

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ity performance, and how buyer approaches to managing CM quality may mitigate its effects.

Early contract manufacturing adopters typically were in industries where process or product characteristics allowed thorough monitoring of quality, often through finished-product inspection. In the textile industry, for example, finished-product quality inspections are highly effective as thorough checks on randomly sampled products catch virtually all possible defects and many key product characteristics endure 100% testing (Romano and Vinelli, 2001). In the electronics industry, also early to employ CMs (Sturgeon, 2002), production lines long have been designed to perform thorough testing of all products at the end of the line, often with in-circuit and functional tests (Terry, 2000).

Some industries increasing their use of CMs more recently, including drug manufacturers (Taylor, 2008), are doing so under high levels of quality performance ambiguity. Cosel in a 2011 Pew Institute report wrote in a section titled “Challenges involved in testing” that “designing a test to capture any unexpected substance in a drug is essentially impossible” (p. 39). Monitoring day-to-day behaviors also can be a challenge when outsourcing. Woodcock and Wosinska (2013), specifically discussing injectable drugs, noted that “firms that contract out manufacturing of their product often do not have the same level of insight into or oversight of the contract manufacturer’s quality systems” (p. 173). Many recent outsourcing arrangements also involve offshore plants, which—while not part of this study—further lowers the buyer’s ability to monitor the CM, increasing ambiguity. CMs and buyers also often share responsibility for many tasks, including raw-material sourcing (Amaral et al., 2006; Brewer et al., 2013), rendering difficult the unequivocal assignment of responsibility for quality failures (Mayer et al., 2004). These conditions pose new demands on the QM literature, which historically has neglected contingencies (Sousa and Voss, 2002; Nair, 2006) and has been slow to adopt a supply chain perspective (Flynn and Flynn, 2005; Foster, 2008; Gray and Handley, 2011; Robinson and Malhotra, 2005).

Motivated by the above discussion, we address two research questions in this study: (1) Does quality performance ambiguity relate to reduced CM conformance quality performance?; and, (2) Which buyer approaches are most effective at mitigating the anticipated negative effects on CM conformance quality performance? We address these questions by examining only outsourced production arrangements, collecting dyadic data from brand-owning buyers and their CMs. We find, as expected, evidence of a strong negative relationship between ambiguity and quality performance. We find strong evidence that CM selection emphasizing quality moderates ambiguity’s negative effect. Surprisingly, one QM-recommended approach—using a single CM for a given product—significantly strengthens the negative ambiguity-CM quality performance relationship. Post hoc, we explain this result through an opportunism lens.

2. Literature review

2.1. Managing quality across firm boundaries

Two shortcomings of the empirical QM literature have been articulated. First, only a few studies have examined the effectiveness of QM practices across firm boundaries (*i.e.*, how the practices and strategies of one firm impact the quality performance of another), spurring calls for the QM literature to adopt more of a supply chain perspective (*e.g.*, Foster, 2008; Kouvelis et al., 2006; Robinson and Malhotra, 2005). Second, the literature long has faced criticism for insufficiently considering contingencies to studied QM practice-performance relationships (Nair, 2006; Sousa and Voss, 2008). We elaborate on each of these in the next two paragraphs.

While lacking a broader supply chain perspective, most empirical QM literature has utilized some version of the multi-faceted, buyer-reported “supplier QM” construct and related it to buyer performance. Some, albeit limited, empirical research exists that explicitly focuses on inter-organizational issues (*i.e.*, how one firm’s approaches influence another’s quality performance). Aron et al. (2008) study quality in offshore-outsourced services, noting their insights do not extend to a production setting. Mayer et al. (2004) study the effectiveness of supply and plant inspections (individually and jointly) on supplier quality, but do not consider relational mechanisms to improve supplier quality. Handley and Gray (2013) examine the formal control mechanisms of facility audits and external failure penalties, showing buyers tend to substitute them in use. They also find these mechanisms, especially when deployed together, increase the CM’s perception of the relative importance that the buyer places on quality. All three papers (Aron et al., 2008; Handley and Gray, 2013; Mayer et al., 2004) notably focus only on formal control mechanisms. A recent study (Handley and Gray, forthcoming) is similar to the current paper, examining the adverse effects on CM quality performance from a key contingent factor: CM heterogeneity, a measure of the diversity of products and processes within a plant. The study then examines whether and how constructs, drawn from the relevant information-processing and attention-based theories, mitigate the effect. The authors find that CM heterogeneity weakens CM conformance quality performance, and suggest a cooperative relationship, contractual coordination provisions, and a formalized assessment program as effective mitigation. In consideration of this study, we include heterogeneity as a control variable.

While the QM literature has faced criticism for failing to consider contingencies in practice-performance relationships (Sousa and Voss, 2002, 2008), some studies have begun to address this. Scholars have studied internal organizational contingencies such as firm size (Jayaram et al., 2010; Ahire and Golhar, 1996; Sila, 2007), the extent of adoption of other programs or practices (Flynn et al., 1995; Cua et al., 2001; Sila, 2007), co-worker support (Joiner, 2007), and organizational culture and/or structure (Douglas and Judge, 2001; Naor et al., 2008; Zhang et al., 2012, 2014). These internal contingencies typically do moderate at least some practice-performance relationships. Others have examined external contingencies, such as environmental uncertainty (Zhang et al., 2012), competitive pressure (Zhang et al., 2014) and national culture or country (Rungtusanatham et al., 2005; Kull and Wacker, 2010; Naor et al., 2010; Sila, 2007), finding the latter has a limited, if not nonexistent, effect on the practice-performance relationship. Industry (Jayaram et al., 2010) and competitive-environment characteristics (Zhang et al., 2012, 2014) do, however, moderate some relationships. The above studies examine the practice-performance relationship within a single firm, and none considers quality performance ambiguity.

While our research design draws from the QM literature, it also heeds calls in the tangentially related supply chain integration (SCI) literature. This literature studies how a firm’s degree of “integration” relates to operational and business performance (Frohlich and Westbrook, 2001; Mackleprang et al., 2014; Rosenzweig et al., 2003; Schoenherr and Swink, 2012). Some studies create one all-encompassing measure of SCI (Cousins and Menguc, 2006; Rosenzweig et al., 2003), while others delineate its dimensions as supplier (upstream), customer (downstream), and internal (cross-functional) (Flynn et al., 2010; Swink et al., 2007; Wong et al., 2011), called “arcs” of integration by Frohlich and Westbrook (2001). Regardless of direction, integration may be tactical (*e.g.*, sharing inventory information), more strategic, or both. Business and operational performance often are assessed, the latter sometimes split into performance dimensions such as cost, quality, delivery and flexibility (*e.g.* Swink et al., 2007). The basic premise

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