



Sourcing Competence in Design and Development Collaboration: A Resource Based View

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Received 18 April 2011; Received in revised form 28 September 2011; Accepted 13 April 2012

Abstract

Recent work in Resource Based View (RBV) calls for functional process level constructs for the resource-performance link, for research into how goals are associated with performance, and for survey research methodologies on managerial perceptions. This paper contributes to these research directions by developing measures and testing hypotheses on associations between design and development collaboration and sourcing competencies. The paper breaks new ground by comparing the relative effects of competencies, goals and product-market characteristics on functional performance. We report on a survey research study with managers in the South East Asia region. We find two competencies, branding and adaptation, and two goals, performance gains and governance flexibility, have significant effects on D&D collaboration. We examine several covariates and discuss the implications of our findings for RBV research and for practice.

Keywords: Sourcing practices, resource based view, Asia pacific region, sourcing goals, collaboration

1. Introduction

Collaboration with suppliers in early stages of design and development is an important ingredient of competitive strategy. An example of global design and development (D&D) collaboration in the APAC region is provided by the “domain labs” of a large consulting firm. The CEO describes collaboration as innovative solutions that provoke joint thinking on next-generation initiatives (Rodrigues, 2007). Enlightened purchasing management seeks to encourage such initiative through superior sourcing practices. Competencies developed through sourcing practices impact the firm’s functional, and eventually, financial performance. What competencies ensure superior sourcing performance? We seek the answer to this question in a major paradigm in strategy research: the resource based view (or RBV) of the firm (Wernerfelt, 1984).

RBV holds that firm competencies seen as resources include organizational processes that improve its efficiency and effectiveness (Barney, 1991). In recent years, strategic management research has extended the scope of RBV in multiple ways. One extension is to broaden the notion of performance from business to functional performance. Recognizing that business process include acquiring supplies and other raw materials, Ray et al. (2004) redirect research to sourcing function level performance which now finds increasing mention in RBV

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**DOI:10.6126/APMR.2013.18.3.05

research. For instance, Cho and Pucik (2005) show that firm level performance improvements often result from resource advantages derived at the level of functional processes.

Managerial goals are being now recognized as drivers of resource advantages. In an extensive review, Crook et al. (2008) conduct a comprehensive meta-analysis of RBV research to examine the links between strategic resources and performance. They find that human and intangible resources, such as those reflected in managerial goal commitments, are more effective than tangible resources on firm performance (p.1149). Ketchen and Giunipero (2004) view supply chains as adhocracies that agree to dedicate themselves to common goals, and engage in purchasing and supply practices aimed at achieving these commonalities. Steinle and Schiele (2008) examine the firm intention in becoming a strategic supplier's preferred customer. Such supplier relations are valuable resources for the firm in the RBV sense. In short, the resource based view has shed light on strategic purchasing in earlier work. Yet goals of sourcing have hitherto not been explicitly included in RBV studies.

In addition to goals, organizational cultures drive resource advantages. Hult et al. (2007) examines a culture of competitiveness and knowledge development in supply chains, both latent resources, from RBV perspectives. Research methods are also being broadened in RBV studies. Nath et al. (2010) point out the dearth in perceptual survey research in the domain. They call for future survey research to reveal how managers perceive RBV constructs and how managers assimilate them into business processes. Quintens et al. (2006) call for non-western locations for further survey research.

What resource advantages drive collaborative sourcing performance in D&D? The paper uses theoretical arguments based in RBV to investigate this question. We argue sourcing practices and goals can influence collaborative performance in the supply base. In particular, we investigate what practices constitute specific sourcing competencies, what is the relative importance of sourcing goals, and how goals and competencies affect D&D collaboration with survey research. We break new ground in linking RBV constructs at functional levels to practices, thereby building a foundation for behavior based scales of competency and performance in sourcing. In addition, we test hypotheses with regression models that link goals, competencies, and product-market characteristics to D&D collaboration. The paper may be the first to make a comparison of the relative effects of competencies, goals and product-market characteristics on functional performance.

The WTO notes that especially in Asia, there are significant re-exports of goods, constituting second tier cross-border sourcing. Several free trade agreements between Asian countries make them attractive for across border sourcing. If the ten member countries of ASEAN were taken as a single economy it would rank as the ninth largest in the world. Moreover, growth rates in the region are among the highest in the world. It is critical for suppliers to forge relationships in high growth regions of the world, such as in the emerging markets of Asia. For all these reasons the setting of the survey research in South East Asia is appropriate. Companies in this region are increasingly integrating into global supply chains, they have a large proportion of their sourcing spend in cross-border procurement, and they service a rapidly growing region of the world.

In the next section we draw upon the literature supporting the view that sourcing practices drive intangible resources, and identify the background for D&D Collaboration. Following sections develop the conceptual framework for our constructs on D&D Collaboration and sourcing competencies; support our hypotheses; describe the methods for survey research; present results of measure development and model estimation; and discuss findings and their limitations. The paper concludes with the implications for research and practice.

2. Literature review

Purchasing relationship building between buyer and seller is a complex process that includes various forms of collaboration (McNally and Griffin, 2007; Chen and Paulraj, 2004). Recently, authors have specifically related collaboration to stages, and argued that collaboration should extend over the life cycle of a product (Schilli and Dai, 2006). Steinle & Schiele (2008) point out the significance of strategic supplier selection itself in attaining preferred customer status. Such supplier relations are valuable resources for the firm in the RBV sense. They take a case study approach to validate their argument that local or global industry clusters determines the value of such resources, and imposes limits on global sourcing and suggests a more appropriate mix of global and local suppliers. Schiele (2012) extends this goal of achieving preferred customer status to engendering collaborative innovation with strategic suppliers. He reports on a consortia benchmarking approach (described in the article) to establish the arguments. Our approach is complementary as it takes a RBV perspective on specific practices that managers adopt that further the firm's design and development collaboration goals. Lehmann and O'Shaughnessey (1974; 1982) have an early paper on investigations in to supplier selection criteria that relates situational factors including D&D of customized products. Meta analysis shows that there is a sales growth advantage with innovation (Bahadir et al., 2009). La Forme et al. (2007) differentiates between structural and procedural models of collaboration. The authors stress the importance of collaboration and relate competencies such as coordination and cooperation to outcomes such as responsiveness, competitor satisfaction and competitiveness. They conclude that four collaboration types emerge: (1) Sharing of production plans and systems; (2) Adaptation of production processes; (3) Common work for cost reduction; (4) Early supplier involvement in new product development (NPD).

Hallikas et al. (2005) discusses single and double loop learning in the context of collaborative strategic planning; and joint development of manufacturing methods. Collaboration is well established as a concern at introduction stages, including new product D&D. Collaboration in new product development and commercialization needs involvement in specification development processes (Min et al., 2007). A primary route to more rapid innovation is supplier collaboration (Piercy, 2009). Dabhilkar et al. (2009) measures collaboration as an active adaptation of production processes for both companies, and early supplier participation in the development of new products. Jean et al. (2010) links relationship learning to collaboration in a cross border context. Their indicators use technology and product information sharing, and adjustments in common understanding of trends in technology. In sum, the literature clearly recognizes the role of collaboration in innovation and early stages of D&D.

Sourcing from multiple global sources allows firms to build greater expertise in international business practices, knowledge of which is of major importance to success in sourcing (Beckmann et al., 2009). Luo et al. (2005) build on previous work that examines the links between firm performance and marketing resources. There is evidence that firms that implement global purchasing reveal better operational level performance. Quintens et al. (2006) conceptualize global purchasing strategy on four dimensions and demonstrate its favorable effect on purchasing performance, a validation of RBV at the level of operational rather than organizational performance. These studies indicate that a more specific operational performance such as D&D collaboration could be successfully linked to global sourcing competencies.

In sum, the literature gives reason to believe collaboration is associated with new product D&D as a performance outcome of sourcing competencies. The limitations of previous collaboration measures as performance outcome constructs are that they remain (1) very

general and not exclusive to D&D collaboration; (2) are dyadic and not oriented to portfolios of suppliers, and (3) do not adequately distinguish between various underlying competencies and the performance outcomes themselves. We therefore propose a collaboration construct that addresses these limitations. Our collaboration construct is complementary in that it examines sourcing practices associated with D&D collaboration as a performance outcome of specific competencies, to evaluate the sourcing side of the relationship. In the next section we review literature on specific sourcing practices that lead to performance and competencies, develop our model and derive our research hypotheses.

3. Conceptual framework

Combs and Ketchen (1999) recommend that scales driven by RBV perspectives may be made more robust through incorporation of Organizational Economics (OE) perspectives. In line with this observation, we seek and include relevant support from OE literature. We next develop the conceptual background for scales on D&D Collaboration, competencies and hypotheses linking them.

3.1 Performance as D&D collaboration

Better sourcing outcomes result from D&D Collaboration between multiple suppliers and a buyer firm. Outcomes that are typical of D&D Collaboration relate to suppliers' understanding of technology cycles and planned obsolescence, rapid response to changes in requirement, and specification development for new products.

Understanding of technology cycles and planned obsolescence: Manufacturers are usually concerned about the timing of product replacement, and the technology cycle. Active ingredients go off patent and firms seek to substitute branded with generic molecules. Components and sub-assemblies in consumer durables must be redesigned to offer new models with superior benefits. The timing of these introductions depends on the clockspeeds of the platform technologies that are involved in the final product. In early work, Bayus (1992) and Bayus et al. (1997) show that timing the introduction of next generation products and differential gains from new product performance are major business concerns. Waldman (1996; 2003) develops the rationale for planned obsolescence by manufacturers of durable goods. Studies of rates of product introduction have found that firms may be able to capture more value from the next generation of product by deliberately shortening the life of the earlier one (Plambeck and Wang, 2009). Strategic purchase behavior from consumers is also responsible for manufacturer obsolescence planning. Song and Chintagunta (2003) and Nair (2004) find empirical evidence for such consumer behaviors, and consequent impact on manufacturer profit.

Rapid response to changes in requirement: Responsiveness is indicative of better D&D collaboration since it compresses the time required to evaluate engineering options. Responsiveness has a big impact on time to market, and is crucial to gaining early penetration in competitive markets. Early work has revealed that manufacturing time is a quarter of total lead time in made to-order goods, and supplier lead time is crucial to meeting deadlines (Zeng, 1998). Ulaga (2003) provides support for this view from grounded research. Terwiesch and Loch (2004) describe the process of collaborative prototyping, where resources are shared between buyer and supplier. The relative speed of prototype development is of great concern.

Kim et al. (2006) examine supply chain innovation from a RBV perspective, and find that it leads to responsiveness. Their scales on responsiveness use terms such as "quickly and effectively" and "promptly" as important descriptions. The sourcing process usually relies on prototype development by a supplier. When the supply base creates solutions to improve coordination, it also improves responsiveness (Burgess and Steenkamp, 2006). Firms report

compatibility of systems that spans suppliers (Spekman and Carraway, 2006). Reactivity and flexibility is highly valued in collaboration (La Forme et al., 2007; Pimentel Claro and Oliveira Claro, 2010). Clearly, value can be created when suppliers respond more quickly to changes in product requirements and business environments. Often innovation in modular design serves to improve response time to design changes. The sourcing function is more highly valued as suppliers respond more rapidly to changes in requirements.

Involvement in specification development: Engineering and purchasing functions are both involved in specification development. Commercializing alternate designs requires both scale and cost comparisons to be considered. The role of early supplier involvement (ESI) in new product commercialization is well known. Takeishi (2001) studies how the automaker's integration of suppliers in internal processes is related to effective coordination (see also Schroeder et al., 2002). Ulaga (2003) describes specification development in similar terms. Firms report that they try to cooperate with suppliers in any way they can. They often plan joint programs, projects or activities together with suppliers (Johnson and Sohi, 2001). However, the climate for cooperation should be conducive to joint specification development. Firms interact with cooperative norms in a cooperative atmosphere (Min et al., 2007; McNally and Griffin, 2007). The quality of such interactions will influence the number of new ideas that arise. An advanced collaboration follows if firms develop many new ideas beneficial to their relationship (Burgess and Steenkamp, 2006). Specification development forms an integral part of interaction for innovation and interfirm coordination (Roy et al., 2004; Kim et al., 2006). There are strong economic reasons for collaborative specification development, as the process is based in innovation, cost, reliability and precision considerations (La Forme et al., 2007). With this understanding of our key construct, D&D Collaboration, we next examine competencies and state our hypotheses that link these constructs.

3.2 Sourcing competencies and hypotheses

Practices are generally thought of as impersonal, stable and continuing and can therefore point to lasting and mature competencies. Competencies are particularly close to maturity indicators, as it may take experience, learning and ability to reach competency. Rozemeijer et al. (2003) discuss purchasing maturity as one of three constructs that affect performance. Schiele (2007) provides a detailed classification of maturity stages in purchasing and argues that maturity is a competency that is rare and hard to achieve. There seem to be two aspects to purchasing maturity. One is "intrafirm maturity" that deals with the recognition and integration of the purchasing function within the firm; and the other is "interfirm maturity" that characterizes the firm's supplier relationship maturity. For instance, intrafirm maturity has to do with whether standardization is defined cross functionally with purchasing, or whether purchasing is involved with target setting for the business. On the other hand, interfirm maturity has to do with whether purchasing seeks inputs from suppliers on technology, or operative procurement targets are agreed with suppliers by strategic purchasing (ibid.). We hypothesize that interfirm maturity stems from sourcing practices that are directed at building sourcing capabilities in at least three ways: tackling constraints, branding and adaptation.

Supply constraint competency: The Supply Constraint Competency (SCC) construct captures the firm's ability to tackle capacity constraints. Its key dimensions are operational, such as expanding the firm's physical supply base by qualification of suppliers; and financial, such as progress payments to suppliers to help smaller suppliers manage their financial capacity.

Qualifying more suppliers will improve the capacity in the supply base potentially available to the firm. Inventory management can be improved with additional sources, where

more than one supplier is used for equivalent purchased products. Some intuition into this practice is that better quality increases product cost, and a substitute lower net cost (even if lower quality) product is desirable as buffer in volatile markets. The lower quality stock is surplus inventory, but sometimes used to meet peaking demand. If additional suppliers are used, inspection or rework could be applied only to main bulk sourced items, thus obtaining economies by foregoing inspection or rework on the additional lots (Chen et al., 2001).

Earlier work has noted advantages from tackling capacity constraints by allowing smaller suppliers to participate in sourcing (Yildirim, 2003), and it might often be the buyer's policy to support additional small sellers. Liquidity and facilities funding are frequent constraints for smaller suppliers. Many governments, for instance, procure from small businesses and must frequently provide work-in-progress payments to finance supply. Resource constraints have historically been circumvented with work-in-progress payments by large buyers, such as government and institutions. The US Department of Defense has long had policies on work-in-progress payments that reduce the contractor's dependence on debt financing. Such financial arrangements serve to provide incentives to suppliers, making the firm's business more attractive. This adds financial capacity to the expanded physical capacity in the supply base that comes from qualifying more suppliers.

Exposure to demand uncertainty may be mitigated by both financial hedging and operational flexibility, both as substitute as well as complementary measures (Chod et al., 2010). It is reasonable to think that firms may use a combination of operational and financial flexibility approaches for suppliers as well. Qualification of more suppliers reflects an operational flexibility measure and progress payment reflects a measure of financial hedging. Overall, qualifying more suppliers and assisting them with progress payments can help deal with constraints.

The SCC construct captures the firm's ability to tackle capacity constraints in sourcing. Choi and Wu (2009) argue that an efficient contract manufacturer provides not only low costs but also rapid access to new process technologies. They are used especially to overcome capacity constraints. However, SCC is more likely to be aimed at effective outsourcing and not at collaboration. Therefore, despite the hypothesis, we expect to see little or no association with D&D Collaboration.

H1: SCC has a positive association with D&D Collaboration (DDC)

Supply brand competency: Supplier Brand Competency (SBC) is the firm's ability to enhance its brand equity by encouraging suppliers to undertake certification and win awards. Dimensions that gain visibility and enhance brand image are "green" branding and quality certification awards.

Green branding is almost two decades old, with consumers expressing their willingness to pay a green premium on an eco-safe product, despite questionable product certification (Wagner, 1997; Wynne, 1994). There is growing concern about product life cycle assessments from depleted resources and carbon emissions, and sustainability in global business practices. "Green procurement" policies provide incentives to suppliers to adopt ecologically sound practices, and all members of the supply loop benefit. While cost reduction and eco-sustainability may be perceived to be in conflict there are complementarities that superior sourcing practices will uncover (see, for instance, Chen et al., 2001). Environmental stewardship is documented in previous work on sourcing as particularly relevant to the firm's brand image, as the entire value chain for the product is assessed in carbon footprinting (Rothenberg, 2007).

Green branding has roots in mandatory steps, such as Waste Electronic and Electrical Equipment (WEEE) and End of Life (ELV) Directives, which spell out industry and government regulations. In addition, non-mandatory standards such as the Global Reporting Initiative or those promulgated by the US Environmental Protection Agency, increase the

propensity of consumers to buy “green” products. Remanufacturing may provide benefits of a green image and branding (Atasu et al., 2008).

While green branding communicates the firm’s position to their stakeholders on sustainability concerns, quality branding speaks to customer concerns on direct benefits. Hendricks and Singhal (1997) find that firms use quality awards to signal the presence of an effective Total Quality Management (TQM) program. Specific company-wide programs, such as TQM, Six Sigma or the Capability Competency Model, are oriented toward infusing all firm functions with a quality assurance concept, though these are very different from ISO 9000 (Corbett et al., 2005). Suppliers must provide assurances through certification. As sourcing markets globalize, the number of firms competing in any program multiply. Buyers are often procuring novel products and services and have little experiential base to accurately discriminate supplier quality. Global quality certification standards vary greatly due to their international origins.

There is buyer pressure to develop a comprehensive governance structure both for cross certification comparisons, as well as cross-functional comprehensive quality certification. The quality of a firm’s product depends not only on its quality but also on the supplier’s quality. OE analysis provides the insight that in general the supplier’s quality is unobservable leading to a moral hazard problem. The moral hazard problem is mitigated by mechanisms such as appraisal, certification, and warranty contracts. Hwang, Radhakrishnan and Xiu (2006) observe that buyers have been eliminating incoming inspection, which is a form of appraisal, and requiring ISO 9000 certification, which is a form of vendor certification. They argue that certification is preferred as it reduces the agency costs generated by inspections.

Kroll et al. (1999) find support for relative product quality and a broad range of competitive business performance measures. Their performance measures include measures such as market share, as well as variance and absolute value of return. The ISO 9000 series of quality management systems standards is widely diffused management practice (Corbett et al., 2005) and has led to quality improvements. Better mandatory or voluntary steps in green branding and quality certification must necessarily be taken with supplier involvement in D&D, resulting in increased D&D collaboration. In sum, SBC is indicated by encouraging suppliers to adopt green policies, and to participate in quality certification processes.

H2: SBC has a positive association with D&D Collaboration (DDC)

Supply adaptation competency: Supply Adaptation Competency (SAC) captures the firm’s ability to better re-align supplier self-interest with the value creation objectives of the firm. This adaptation may be achieved through appropriate adjustments of agency incentives and productive resources available in the supply chain. Supporting practices are renegotiations and resource sharing. Therefore, SAC captures the firm’s ability to use contract adjustments and re-allocation of resources to align supplier self-interest and endowments with the value creation objectives of the firm.

OE studies recognize the need to provide the right incentives for innovation through contracting. In an early analysis, Ramsay and Wilson (1990) show strong information acquisition reasons to recommend multiple sourcing with short-term contracts as a governance mode. Park et al. (2000) show that single sourcing leads to inadequate contractual safeguards. They argue that long-term relations as well as short-term ones with suppliers are better governed by short-term contracts. Sourcing managers are concerned about maintaining an expectation of cost competitiveness in their supply base, and often share resources with suppliers to speed them on the learning curve. One approach is to subsidize an initially higher cost supplier with more than its due share of business in order that it benefits from learning curve effects. Poppo and Zenger (2002) find support for the proposition that modes, such as formal contracting and relational governance, are complementary and can support each other.

The use of short term contracts leads to frequent renegotiation. Renegotiation of contracts

becomes necessary as learning in the sourcing process leads to design changes. Roels et al (2010) study the role of contracts in collaborative design processes. Iyer et al. (2005) study the contracting process for product specification and production, where product costs depend on both the buyer's and the supplier's resources. Gulati et al. (2005) study governance of adaptation in sourcing and find performance differences across modes of procurement. Schiele (2007) notes that mature purchasing can assist in determining the potential for adaptation. DDC is aided by this competency, as both parties can add economic value through adaptation. He also notes that internal and external resources are available on demand to projects that aids in DDC. Fang, Palmatier and Evans (2008) demonstrate that customer participation affects new product value creation through various coordination, investments and information sharing approaches, all routes to adaptation. Hence:

H3: Supply Adaptation Capability (SAC) has a positive association with DDC

3.3 Control variables

In order to better isolate the hypothesized effects of competencies on DDC we include control variables. We include four sets of control variables as described next. (1) *Goal importance*: Firm goals are associated with DDC as goals are found to impact performance (Crook et al 2008; Ketchen and Giunipero, 2004). Five sourcing goals had been initially identified from the business-to-business marketing, organizational economics and contracting literature (our sources are Seshadri, 2005, and Hutt and Speh, 2008, and the references therein). The five goals identified are: *Total acquisition cost*: the cost of the cost of goods sold, including the cost of purchasing and commissioning, maintenance, any ancillary costs, and any administrative costs for capital equipment, or MRO supplies related to suppliers. *Performance gains*: the improvement in product or service performance or value to your clients that results from the use or inclusion of suppliers. *Capacity management*: the ability to better manage production or service Capacity on account of the suppliers' products or Capacity purchased. *Governance flexibility*: the ability to better manage your business including better management of relationships with other suppliers and clients. *Renting Competencies*: gaining access to specific abilities of suppliers that become available to as a result of purchases or contracts with them. (2) *Product-market performance*: Product-Market performance controls at a time of economic downturn are represented by *Shrinkage in Spend* and *Growth rate*. (3) *Firm classification*: Firm Classification controls are represented by several "firmographics" such as age, and number of sourcing locations. (4) *Product classification*: Product Classification controls are whether the product is an OEM, MRO or Service.

In summary, the association of competencies with DDC is captured in the three key hypotheses on the associations between competencies on D&D Collaboration. Four sets of control variables will help isolate the hypothesized effects. The next sections describe the survey methods and develop the empirical sections of the paper.

4. Method

An online survey instrument was developed with four sections. Section 1 was titled Global or Local Sourcing and dealt with globalization of the firm's sourcing function. Section 2, Sourcing Goals, dealt with the relative importance ratings given to various sourcing goals. Respondents were instructed to focus here on sourcing for their *most important product-market* and to provide a relative importance rating for goals on a constant sum scale. Lehmann and O'Shaughnessey (1974; 1982) introduced constant sum scales in industrial contexts, and DeSarbo et al. (1995) investigated multivariate analyses approaches for constant sum importance rating scales in segmentation. In current work, Zablah et al. (2010) employ a

similar constant sum scale to measure the importance of six attributes in product choice decisions in B2B markets. Section 3 was titled *procurement characteristics*. Respondents were instructed to consider possible practices in routine procurement processes, and offer their opinion on Likert scales that captured use of the practice in their procurement. A final Section 4 was titled *demographics*, and contained items for the purpose of classification.

Data collection was done during April 2008 to November 2009, following the internet survey method suggested by Dillman (2000). This long survey time frame covers most of the global recession that lasted from end 2007 to mid 2009 and the slow recovery. Purchasing Managers' names and phone numbers were generated from the *OneSource* online database for countries in South East Asia. These managers were based in Singapore, Malaysia, Indonesia, Thailand, Hong Kong, and Philippines. A total of 265 potential participants were identified by telephone calls and emailed with the link to the online survey. Responses to the first page item on how the downturn was affecting procurement spend indicated 133 respondents visited the site and began the survey, an item response rate of 50.12 percent. Not all who visited the site proceeded with the survey. There were 51 usable responses for section 3, which was the crucial section for our hypotheses. This indicated an overall completion rate of 19.25 percent, and of 38.35 percent from those who visited the site. The results of independent samples t-test for non response bias for procurement spend shrinkage, number of supplier locations and global proportion of spend are significant only for the shrinkage in spend item. All other means are not significantly different (similar to Armstrong and Overton 1977). We next turn to sample analyses and results.

5. Analysis and results

We first describe the sample, and then develop the validity and reliability analyses for measurement scales. All hypotheses involving these measures, goals, and other control or classification variables were tested with the regression models reported in this section.

5.1 Descriptive analysis

Table 1 contains a summary description of the sample. Five sourcing goal importance ratings were solicited on a constant sum. The most variation in importance rating was for Total Acquisition Costs (min 0; max 75; mean 40.37; std dev 16.81), almost twice as important as the next, Performance Gains. However, with the exception of Total Acquisition Cost all are non-price goals; therefore, the importance of price-to-non-price goals breaks down as 40-60. Total Acquisition Cost's relative importance was significant and high negative correlation with all the other goals, ranging from $-.735$ to $-.338$. As cost driven goals were not directly related to our hypotheses about D&D Collaboration, this variable was dropped from further analysis. Of the remaining four, Performance Gains was the most important, followed by Governance Flexibility, Renting Competency and Capacity Management in that order.

Table 1. Descriptive statistics of sample

	Annual revenues (US\$ m)	Number of employees	Firm age	Manager's years in role	Annual sales growth percent	Market share for leading product percent	Procurement spend shrinkage in last year percent	Number of supply locations	Proportion of spend on global sources percent
Mean	563	1,845	38.2	8.16	11.26	27.76	27.19	27	47.66
Median	66	300	34.0	5.50	9.50	23.00	22.50	8	50.00
Min	1	14	5.5	1.00	1.00	2.50	1.00	1	2.00
Max	7,000	37,500	100.5	24.00	37.50	65.00	85.00	502	100.00

Country of central procurement location	Frequency	Percent
Singapore	19	14.3
India	5	3.8
Malaysia	5	3.8
Philippines	5	3.8
Australia	4	3.0
Japan	2	1.5
USA	2	1.5
China	1	.8
Indonesia	1	.8
Maldives	1	.8
Sweden	1	.8
Missing	87	65.4
Total	133	100.0

Product classification		
	Frequency	Percent
Components	20	15.0
Assemblies	18	13.5
OEM	6	4.5
MRO	4	3.0
Services	3	2.3
Utilities	2	1.5
Missing	80	60.2
Total	133	100.0

5.2 Validity and reliability of measures

Diamantopoulos and Winklhofer (2001) discuss the choice between reflective and formative specifications for scales. In line with their recommendation that the choice be primarily based on theoretical considerations on the direction of causal priority between the indicators and latent variable, we chose reflective scale specifications. In our study the direction is from latent managerial competencies or D&D collaboration to indicator practices.

We operationalized our measurement scales using a process recommended by Gerbing & Anderson (1988) as follows. (1) We developed items related to concepts discussed in 3.1 and 3.2. All items could be responded to on five point continuous rating Likert scales. The items

were tested for clarity in a limited mail survey in Singapore. To reduce confirmation bias the items were re-grouped into independent pages of the online survey. (2) On conclusion of the online survey, we conducted an initial exploratory factor analysis. Fourteen items loaded cleanly, with eigenvalues greater than 1, on four principal component factors obtained with varimax rotation. The four factors explained 62.8 % of the variation and their items loadings were: (i) *Factor 1*: ProdCycSup, .843, SpecDevSup, .737, RapdResp, .689 and ProdGnsSup, .664; (ii) *Factor 2*: ProgPynt, .798, ManySuppQlfd, .789 and ScndSrc, .575; (iii) *Factor 3*: ShrAdj, .842, RenegFreq, .680, InnovSupp, .513 and ResShrng, .477; and (iv) *Factor 4*: SuppCertAwds, .794, GrnPrcPol, .762, and QualAssnc, .669. (3) Confirmatory Factor Analysis (CFA) was conducted on the items with the four latent factors. CFA fit diagnostics were used to further eliminate items that did not contribute to convergent validity and scale reliability. All retained items had standardized factor loadings from the CFA of more than 0.40 (as recommended by Hulland, 1999). Composite Reliability (CR) levels were above the suggested cut off of 0.70 for all but the SAC scale (Hair et al., 2003). Chronbach alpha levels were all acceptable and above the 0.60 level recommended as a threshold for new scales in strategy research (Ray et al., 2004). In addition, Peter (1979) recommends values of 0.5 and above for fewer than four item scales to be acceptable. (4) Items that passed the previous step were subjected to a discriminant validity test for the four constructs, as recommended by Fornell and Larcker (1981). Steps 3 and 4 together resulted in elimination of one item from each of the sourcing competency scales, resulting in a two item scale for each of Supply Constraint Competency, Supply Brand Competency and Supply Adaptation Competency; and a three items scale for D&D Collaboration. The average variance extracted AVE was over 0.5 for all but one scale. The Supply Adaptation Competency scale with an AVE of 0.48 was retained, however, as conceptual support was strong. The square of CFA pair wise (ϕ) correlations between constructs were all lower than the average variance extracted (AVE, in the diagonal cells) which supports discriminant validity. See Table 2 for the scale items, convergent validity and scale reliability statistics. The five eliminated items, ProdGnsSup, ScndSrc, QualAssnc, InnovSupp, and ShrAdj, are listed at the end of Table 2. See Table 3 for the discriminant validity statistics. Table 4 reports pairwise correlations for retained scale items. (5) Validity was further supported with subsequent model analyses: (i) CFA for the measurement model showed correlations as expected between the latent constructs, and fit diagnostics were acceptable; and (ii) Regression models support the majority of hypotheses.

The final measurement scales for D&D Collaboration, Supply Constraint Competency, Supply Brand Competency and Supply Adaptation Competency were obtained as averages for the corresponding scale items. Note that a higher score on DDC indicates a higher level of D&D Collaboration; and similarly higher scores on SCC, SBC, and SAC indicate higher levels of competency.

Table 2. Measurement model statistics

Convergent validity is reported in the table for the four scales.

Strongly= 1:--:--:--:--:5= Strongly agree disagree	St. Loading	t-value	Average Variance Extracted (AVE)	Composite Reliability, Chronbach's alpha
<i>D&D Collaboration DDC</i>				
Our suppliers respond rapidly to changes in our requirements [RapdResp]	.51	3.64	.57	.79, .78
Our suppliers understand the technology cycles and planned obsolescence routine for our product-market [ProdCycSup]	.82	6.48		
Suppliers are deeply involved in our specification development [SpecDevSup]	.89	7.17		
<i>Supply Constraint Competency SCC</i>				
We like to qualify as many suppliers as possible [ManySuppQlfd]	.59	3.32	.55	.71, .67
We provide our suppliers with Progress Payments [ProgPymt]	.87	4.08		
<i>Supply Brand Competency SBC</i>				
We have "green procurement" policies in place to encourage suppliers to adopt ecologically sound practices [GrnPrcPol]	.97	5.04	.65	.78, .74
We require suppliers to participate in certification and quality awards [SuppCertAwds]	.60	3.69		
<i>Supply Adaptation Competency SAC</i>				
Renegotiation with our suppliers due to design changes is frequent [RenegFreq]	.69	4.42	.48	.65, .62
We share resources with our suppliers in order to reduce their costs [ResShrng]	.70	4.51		
<i>Fit Statistics of Measurement Model: Degrees of Freedom=21, Chi-Square=31.19 (P=0.071), RMSEA=0.07, NFI=0.85, NNFI=0.90, GFI=0.90, Standardized RMR=0.10.</i>				

Note.

Items dropped from respective scales during the scale refinement process:

DDC: Productivity gains of our suppliers in recent years has been huge;

SCC: We second source as an inventory management practice;

SBC: We apply a Quality Assurance, Six Sigma, capability competency, or similar model for our suppliers;

SAC: Our suppliers are chosen because they are innovative; We adjust our share of procurement spend to reward lower cost suppliers with more business.

Table 3. Discriminant validity of the latent goal variables

Diagonal values are AVE and off diagonals are the squared correlations from the CFA

	D&D collaboration	Supply constraint competency	Supply brand competency	Supply adaptation competency
D&D collaboration	0.57			
Supply constraint competency	0.18	0.55		
Supply brand competency	0.26	0.04	0.65	
Supply adaptation competency	0.42	0.23	0.19	0.48

Table 4. Correlation matrix for measurement model

	RapdR esp	ProdC ycSup	SpecD evSup	Many Supp Qlfd	Prog Pymt	GrnPr cPol	SuppC ertAw ds	Reneg Freq	ResS hrng
RapdResp	1								
ProdCycSup	.519**	1							
SpecDevSup	.375**	.732**	1						
ManySuppQlfd	-.019	.134	.335**	1					
ProgPymt	.112	.203	.401**	.518**	1				
GrnPrcPol	.417**	.335**	.459**	.142	.153	1			
SuppCertAwds	.311*	.243*	.244*	.068	.032	.587**	1		
RenegFreq	.221	.412**	.371**	.008	.276*	.363**	.241*	1	
ResShrng	.282*	.322*	.438**	.340**	.314*	.235*	.133	.484**	1

Significance levels: * <0.1; ** <0.05

5.3 Model estimation

Multiple Regression Analysis (OLS) was used to test the hypotheses. The results of the multiple regressions are shown in Table 5.

Three models were tested with the same dependent variable, D&D Collaboration. Model 1 was a full model with *perceptual variables*, including the competencies, goal importance, perceived impact of the recession on shrinkage in procurement spend and long term market growth averages, several classification dummy variables at the firm and product levels as controls. Model 2 included the previous variables, without the firm and product level control variables. Model 3 was a final model that retained variables with significant coefficients only.

Table 5. Hypothesis tests and regression estimates
Higher scores on DDC (dependent variable), SCC, SBC, and SAC (independent variables) represent a higher collaboration or higher competency rating.

Variables	Standardized coefficients		
	F = 2.394 (.025); Adj R ² = .380	F = 4.065 (.001); Adj R ² = .375	F = 7.93 (.000); Adj R ² = .519
<i>Independent variables</i>			
SCC	.026	.149	.
SBC	.417**	.401*	.372***
SAC	.371*	.352**	.312**
<i>Goal importance controls</i>			
Performance gains	.307**	.232*	.282**
Governance flexibility	.103	.196	.197*
Renting competency	.117	.110	
Capacity management	.048	-.039	
<i>Product-market performance controls</i>			
LN[% Shrinkage in spend]	.354**	.231*	.272**
LN[% Growth rate]	.073	-.130	.
<i>Firm classification controls</i>			
Global spend	.424**		.346***
Firm age	.052		
Number of employees	.140		
Years manager in role	.104		
Number of locations	-.281		
Developed central proc	.087		
<i>Product classification controls</i>			
Dum_Components_OEM	.482***		.285**
Dum_MRO	.252		
Dum_Services	.030		

Significance levels: * <0.1; ** <0.05; *** < 0.01

Hypotheses tests: H1 was not supported. SCC did not have a significant association with DDC. The direction of the effect was positive as hypothesized but in both models 1 and 2 the effect was not significant at the 0.1 level. H2 was supported. Effect sizes of SBC on DDC were significant, positive and among the highest in all three models. Significance was very high, better than .01 in model 3 and better than .05 in model 1. H3 was supported. Effect sizes of SAC on DDC were significant, positive and also among the second highest in all three models. Significance was better than .05 in model 2 and 3.

Control variables: Interestingly, each of the four sets of controls contributed a single significant variable in Model 1. Two of these sets, the goal importance rating and the product-market performance controls were used as control variables in Model 2 while all other firm and product level control variables dropped. Only performance gain importance was significantly associated with D&D Collaboration in all models. Governance flexibility was significantly associated with D&D Collaboration only in Model 3. The Performance Gain

coefficient was large and significant. Positive signs for effects of goals importance indicated its higher relative importance was associated with better D&D Collaboration.

Model 2 showed that level of shrinkage had a significant positive association with DDC. Therefore the higher the shrinkage in procurement spend due to the recessionary environment, the greater D&D collaboration performance. The rate of growth did not have a significant effect, but the positive coefficient indicates greater growth rates are associated with greater D&D Collaboration.

Model 3 had the best fit and significance ($Adj R^2=.519$; $F=7.93$). Comparison of Model 3 with the previous models shows that two variables as significant at the .05 level. Global Spend and the indicator for engineered product class (OEM and assemblies) have significant positive coefficients. The base class is component products. The positive coefficient implies a higher global spend leads to greater D&D Collaboration; and engineered products have greater D&D Collaboration than components. Interestingly, whether the central procurement office was located in a developed country (the indicator variable Developed Central Proc=1, including Singapore, Japan, Australia, US and Europe) or in an emerging market (including India, China, Philippines, Malaysia, Indonesia and Maldives) did not turn out significant.

Model 1 shows that results were robust to the inclusion of five other firm control variables and two other product control variables, as they did not have significant effects. Firm age, Number of Employees, Years Manager in Role, Number of Locations, country of central procurement HQ location, and whether the product was component, MRO or service had no significant impact on D&D Collaboration. In the next section, we discuss the implications of these findings.

6. Discussion

The findings from the regression models provide our key insights. As hypothesis H1 was not supported, we conclude supplier constraints do not appear to inhibit D&D Collaboration. We had expected this hypothesis to be disconfirmed. Possible explanations are that suppliers that engage in D&D collaboration are usually larger and do not have limiting inventory and financial constraints. Therefore, a sourcing competency on constraints of suppliers will not get them to engage in D&D Collaboration, but may be more relevant to other types of performance. Dabhilkar et al. (2009) find that collaboration is not most important for certain kinds of performance improvement, for instance, for improved cost performance.

Supply Branding Competency has the highest effect on D&D Collaboration (H2 supported). Recall that SBC measures competency in encouraging supplier environmental and quality branding through certification and awards. Blair et al. (2008) argue that the use of third-party non-governmental standards setting, inspection, assurance and certification of supplier processes and quality is rapidly becoming extremely important in global business. They call this the fourth enforcement mechanism, in addition to the other three of organization within the firm, organization through contract, and reputation enforcement mechanisms. Zablah et al. (2010) find that supplier effects on brands have a high relative importance in industrial purchase situations. Global businesses realize that their brand value can be exposed to risk due to weaknesses in the supply chain, and voluntarily drive suppliers to adopt, for example, ISO 9000 (for quality) and ISO 14000 (for environmental) certification standards. Such certification is the most important antecedent we find for D&D collaborations.

Supply Adaptation Competency has the second largest effect on D&D collaboration (H3 supported). Contractual agreements must be renegotiated and resources must be re-allocated for collaborative development to flourish. As new ideas and processes are implemented there is need to be flexible in buyer-supplier arrangements, and sourcing should seek out ways to

optimize agreements on a continuing basis. The finding is consistent with other studies. Fynes et al. (2005) distinguish between design quality and conformance quality but argue that cooperation, closely resembling practices underlying Supply Adaptation Competency, is necessary for both. Spekman and Carraway (2006) use the term “full network optimization” to distinguish a collaborative relationship (where adapting to an optimum would be necessary) from a transactional relationship.

In his influential paper, Day (2000) lists shared incentives and goals as drivers of collaborative relationships. We find that Performance Gain goal importance is positively associated with D&D Collaboration. Buyers seek alignment on supply chain vision and goals (Min et al., 2007). Johnson and Sohi (2001) argue for alignment of infrastructure and workflows in a structural approach to collaboration. We find Governance Flexibility goal importance is also positively associated with D&D Collaboration. The importance of flexibility in managing sourcing processes over time drives better D&D collaboration. Cannon et al. (2000) find that performance depends importantly on governance structures when transaction uncertainties are high. This is likely to be the case when firms seek D&D collaboration. Wang et al. (2008) show that governance structures affect creativity in buyer-seller relationships, with trust and contracts having a positive role and power a negative one. They argue that creativity will impact collaboration efforts.

We find that Renting Competencies of suppliers and Capacity Management goal importance do not affect D&D Collaboration significantly, although their goal importance is positively associated. It could be these goals drive outsourcing activities and therefore do not drive collaboration in the manner of Performance Gain and Governance Flexibility. Two significant motivations for outsourcing identified by Devinney and Perm-Ajcharyawong (2008) are cost reduction and innovation. Renting Competencies corresponds to outsourcing motivations they identify of value appropriation, and Capacity Management to motivations of contractual efficiency. Both of these relate to the ability of outsourcing to deliver cost advantages without organizational liabilities.

Shrinkage in procurement spend during the recession is found to be the only significant product-market performance control. The positive association implies better D&D collaboration is likely to be sought when the firm is less recession proof, and suffers greater exposure to market volatility. Such firms should be more inclined to strategies of flexible capacity, and utilization of supplier assets that could be reduced in downturns. The only significant firm level control is found to be global market spend. The positive association implies the larger this spend the better D&D Collaboration. Firms with greater global spend are more likely to be involved with innovation in a collaborative manner. Li and Vanhaverbeke (2009) show that for innovation it is important to seek suppliers from the same or nearby countries for the sake of coordination and communication, but to seek them from other industries in order to have access to complementary external knowledge. The greater the global spend, the more likely is this access and enhanced D&D Collaboration. The only significant difference due to product classification is found to come from engineered products, including assemblies and OEM products. This finding conforms to our intuition since these product classes have inherently more joint design choices, and are found to have a much higher association with D&D Collaboration than components, MROs and services.

Limitations and future research: The research has some important limitations. The sample was screened to exclude purchasing managers who do not specifically source across borders. As it explores sourcing practices rather than buyer-supplier relationships, we are unable to compare local and global/international sourcing supplier collaboration. Clearly, the measures and model will benefit from larger datasets that allow scale validity and reliability checks across geographies and business cultures. Finally, as the study assured anonymity and employed the survey approach, it was not possible to link extensive financial information for

classification. It was not possible therefore to use standard organizational performance measures for the resource-performance link and test the mediating and moderating effects of sourcing performance on business performance. We next conclude with the key implications of the research.

7. Conclusion

The paper was motivated by the observation that collaboration behavior is critical for design and development, yet research does not explicitly study related sourcing performance and competencies. Employing the Resource Based View of the firm we conceptualize a performance measure of D&D collaboration from the behavioral standpoint, driven by practices. We argue that sourcing competencies are practices that get established in the firm over a period of time, and identify three such competencies. We conceptualize measures for Supply Constraint Competency, Supply Brand Competency, and Supply Adaptation Competency and hypothesize their associations with D&D Collaboration. We report on survey research of Asian managers, establish the reliability and validity of our measures, and estimate regression models involving these measures along with sourcing goals, and several covariates. Our results support positive associations between these competencies, specific sourcing goals and D&D Collaboration performance. Our findings have several implications.

Implications for research: D&D Collaboration contributes to a trend in RBV research to isolate performance constructs at the functional level. It is complementary to other constructs related to collaboration, which have hitherto not specifically focused on design and development stages of a sourcing relationship. The validity and reliability checks on the measurement scale for D&D Collaboration demonstrates the viability of behavioral items such as practices for RBV constructs. We identified three further competency constructs based on practices. The behavioral standpoint is a bridge to other research streams, such as research on alliance capabilities that explores the role of internal processes in shaping external relationship outcomes and performance (Kale and Singh 2009; Heimeriks and Duysters 2007; Ireland et al 2002). For instance, constructs of sourcing competencies based on practices are analogous to alliance capability. Future research on functional practices could fruitfully link RBV and other research streams.

Despite Day (2000), collaboration research has not paid due attention to goals. More recently, Spekman and Carraway (2006) argued for superior collaboration resulting from characteristics such as transparency of information and mutual goals, with a high degree of alignment in strategy, goals and objectives. We find two such goals, performance gains and governance flexibility, significantly drive D&D collaboration. Developing further RBV performance constructs at functional or operational levels such as D&D collaboration would require renewed attention to functional goals. Moreover, market cycles and macro-economic events influence performance metrics and should reflect in future work that links competencies to performance. By including market level covariates, we show that greater shrinkage in procurement spend in recessionary times is associated with higher D&D collaboration. We investigate several firm and product classification variables that could influence D&D collaboration, and find that its performance is robust in most of them. The ones that do matter are global spend and engineered products, both of which are positively and strongly associated with greater D&D collaboration. Clearly, further investigation of classification variables would be useful.

Implications for practice: D&D collaboration is strongly associated with supplier branding competency. A practical recommendation from this research finding is that supplier certification should accompany D&D Collaboration. Global business increasingly needs suppliers to be more than merely cost effective. Purchasing managers need suppliers to

demonstrate their efforts at improving both quality and environmental sustainability. Programs like GRI, the Global Reporting Initiative, and ISO certifications should be encouraged as they help brand the supply chain. South East Asian companies are increasingly integrated into global supply chains, and a supply brand competency of this kind is associated with D&D collaborations. While supplier selection processes can help, contractual incentives based on metrics to reward suppliers for branding efforts could be more effective. These metrics are becoming increasingly available with deployment of information management. Aberdeen Group has recently reported on how best-in-class companies use interconnected business processes and technologies to improve visibility into key energy and carbon metrics, for intelligent decision making.

A competency in adaptation is a close second for D&D collaboration. Purchasing managers should adjust sourcing programs and manage flexibility in contractual agreements. Purchasing managers espousing goals of performance gains and flexible governance are more successful at D&D collaboration. The alignment of goals and competencies should be more than accidental. Dynamic mapping processes for sourcing goals and competencies such as that adopted by Bain, the consultancy, would help ensure their alignment (Rigby 2011). South East Asian companies experiencing rapid growth in changing marketplaces should be particularly cognizant of adaptation competencies.

South East Asian companies face high exposure to volatile markets due to export driven economies. Moreover, their fraction of global spend is high due to significant cross-border sourcing. Our research demonstrates that both situations are reasons to seek higher D&D collaborations. In conclusion, practices that build competencies in branding and adaptation in a rapid growth region of the world are of increasing importance, and affect the larger world economy. These competencies along with clearly articulated goals on performance gains and governance of the supply function are strongly associated with superior D&D collaboration.

Acknowledgement

I thank two anonymous reviewers for their valuable suggestions in revising this paper. I also gratefully acknowledge partial support for this research from the NOL Fellowship under grant C216/MX09B001 and from Office of Research at SMU under grant 08-C207-SMU-012.

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