

RESEARCH NOTES AND COMMENTARIES

RECONCEPTUALIZING PLURAL SOURCING

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Firms often procure the same input via multiple means, e.g., making and buying. Recent papers have yielded rich, but inconsistent, theoretical and empirical insights. Resolving these inconsistencies requires reconceptualizing two aspects of plural sourcing: what and how. We reconceptualize plural sourcing as a set of combined governance modes—make-and-buy, make-and-ally, and buy-and-ally—which differ in their capabilities and limitations. We demonstrate our reconceptualization's potential with propositions predicting the choice of specific plural sourcing modes. Copyright © 2013 John Wiley & Sons, Ltd.

INTRODUCTION

What is the best governance mode (i.e., make, buy, or ally) through which to procure a given input? Answering this question has a long tradition in management literature (e.g., David and Han, 2004; Oxley, 1997; Williamson, 1985). Typically, this question has been answered in either-or terms, favoring one governance mode over another depending on the underlying transaction characteristics. However, recent research has begun to explore the possibility that firms combine governance modes to better respond to a rapidly changing environment and increasing knowledge and performance requirements, a phenomenon referred to variously as plural, dual, or concurrent sourcing, tapered integration, make-and-buy, or parallel sourcing (e.g., Parmigiani, 2007; Parmigiani and Mitchell, 2009).

Keywords: plural sourcing; concurrent sourcing; make-and-buy; tapered integration; governance choice; similarity

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Plural sourcing is a governance form where multiple governance modes of make, buy, and ally are combined in a systematic way. It does not sit between the individual governance modes, but rather is a combination of multiple governance modes in their full manifestation (Bradach and Eccles, 1989). While the concept has a long history, reaching back at least to Adelman (1949) and Kessler and Stern (1959), recent work (e.g., Gulati and Puranam, 2006; Heide, 2003; Parmigiani, 2007; Parmigiani and Mitchell, 2009) has created a critical mass of theoretical and empirical insights into the phenomenon.

The recent growth of the literature has revealed strains across theoretical conceptualizations of plural sourcing and the empirical results they yield. Authors have offered multiple theoretical explanations for plural sourcing ranging from safeguarding against opportunism (Heide, 2003) to technological uncertainty and learning (Bradach and Eccles, 1989). Empirical findings have varied across papers producing conflicting findings on the role of, for example, performance ambiguity (Heide, 2003; Parmigiani, 2007) and volume uncertainty (Harrigan, 1984; Parmigiani, 2003). We believe the time is ripe to revisit the body of highly insightful

individual works in a more holistic sense, resolving some of the strains between them and laying a more theoretically consistent foundation for examining plural sourcing. We begin by observing that there are two substantial areas in need of reconceptualization: “what” and “how.”

By *what*, we refer to a surprising lack of clarity regarding what actually represents plural sourcing. Generically, plural sourcing refers to the simultaneous occurrence of multiple governance forms for the sourcing of the “same input.” However, the boundaries of *same* are inconsistently defined across and even within papers. Few would disagree that making and buying a given grade of coal represents plural sourcing. Nor would many suggest that buying automotive tires and making car doors is an example of plural sourcing. However, an empirically and theoretically relevant gray zone exists: Does making 80 GB hard drives and buying 120 GB hard drives qualify as plural sourcing? Would conducting exploratory research via an alliance and conducting slightly less exploratory research internally qualify? We will show how different conceptions of *same* have manifested in the literature, clouding theoretical progress and perhaps generating seemingly contradictory empirical results. We then reconceptualize *same* as a spectrum of degrees of “similarity” and propose how similarity might be measured.

By *how*, we refer to the governance modes combined in plural sourcing. The overwhelming majority of the literature has considered the combination of make and buy (e.g., Gulati and Puranam, 2006; Parmigiani, 2007). However, other combinations of governance modes, such as make-and-ally or buy-and-ally, are equally valid theoretically and are observed in practice (e.g., Veugelers and Cassiman, 1999). Therefore, we reconceptualize plural sourcing as a set of combined governance modes—make-and-buy, make-and-ally, and buy-and-ally—that are distinguished from single modes of governance by certain shared characteristics, but also differ from each other in their particular capabilities and limitations.¹ This reconceptualization provides a common framework for studies of different plural sourcing modes. Additionally, it provides the foundation for more

nuanced consideration of the relative benefits of each mode in specific circumstances.

To begin our reconceptualization, we examine the limitations of both *what* and *how* in their current conceptualization. We then introduce our proposed reconceptualization of each, discussing their theoretical motivation and practical application. Next, we demonstrate the potential of our reconceptualization by incorporating them into a set of propositions, which predict the use of plural sourcing and the choice of specific plural sourcing mode as a function of similarity and two dimensions of uncertainty: technological volatility and performance ambiguity.

RECONCEPTUALIZATIONS OF PLURAL SOURCING

Reconceptualizing *what*: moving from the *same* to degrees of similarity

Most extant studies similarly conceptualized plural sourcing as procuring the same input via multiple means. For example, Gulati and Puranam (2006: 3) stated that “[F]irms often make and buy the same thing.” While *same* has a seemingly clear meaning, “identical,” the literature has struggled with. As Table 1 shows, multiple papers discuss differences among the same inputs that are being sourced, even though there can logically be no differences among identical inputs. For example, Azoulay and Henderson’s (2001) study of concurrent sourcing in drug development found that “there existed inside pharmaceutical firms a core of ‘insiders’ that are engaged in exactly the same activities as external suppliers.” However, they also identified relevant differences in the “exact same” activities: “We have shown in previous work that the allocation of projects to inside and outside teams present a very specific pattern: *knowledge-intensive* projects are more likely to be assigned to internal teams, while *data-intensive* projects are more likely to be outsourced.” (Azoulay and Henderson, 2001: 22; emphasis in the original).

Beyond the logical contradiction posed by variation among inputs that are putatively the same, the uncertain and elastic definition of *same input* calls into question the appropriate definition and boundaries of plural sourcing. While the same input may be difficult to delineate precisely from a “very similar input” because

¹ Trinary modes, e.g., make-and-buy-and-ally, have also been observed. For simplicity, we constrain our theoretical development to the situation of two modes being combined.

Table 1. Conceptions of sameness of plurally sourced inputs

Paper	Type of input	Conceptualization of the “sameness” of inputs	“Same” or “similar”?
Azoulay and Henderson (2001)	Drug development activity	“[T]here exists inside pharmaceutical firms a core of ‘insiders’ that are engaged in exactly the same activities as the CRO employees.” (p. 22; emphasis in the original)	Similar: “[K]nowledge-intensive projects are more likely to be assigned to internal teams, while data-intensive projects are more likely to be outsourced.” (p. 22; emphasis in the original)
Heide (2003)	Components purchased by OEMs in general machinery, electrical and electronic machinery, and transportation equipment	“This article examines the phenomenon of <i>plural governance</i> , a firm’s simultaneous use of market contracting and vertical integration for the same basic transaction.” (p. 18)	Unclear: Measurement of dependent variable: “What percentage, if any, of your needs for this component do you produce internally?” (p. 21); “this component” is not clearly defined
Parmigiani (2007)	Five inputs: die design, die build, die maintenance, part machining, part coating	“‘Concurrent sourcing’ emphasizes that firms are making and buying the <i>same</i> good, in contrast to considering a broader unit of analysis and/or one with more heterogeneity.” (285; emphasis in the original)	Similar: Input similarity is measured as control variable. Results show that more similar inputs are rather concurrently sourced than bought
Veugelers and Cassiman (1999)	Innovation activity	“[...] the decision of the innovative firm to produce technology itself (Make) or to source technology externally (Buy) [...]” (p. 63)	Similar: Inputs are complementary. “But there are ample arguments to stress the complementarity between in-house R&D and external know-how [...]” (p. 64)

the salient feature which determines similarity depends on the context in which the inputs are compared (Tversky, 1977), identifying and evaluating relevant differences between putatively same inputs is crucial both theoretically and empirically. From a theoretical perspective, it is important to ensure that inputs that are sourced via plural sourcing are sufficiently similar to constitute plural sourcing. For example, sourcing specific inputs internally and generic inputs externally is not necessarily plural sourcing because the choice of different sourcing modes can be explained by relevant differences in the underlying transaction (Williamson, 1985).

Confusion in delineating exactly the same inputs from very similar inputs may imply that some

papers that intend to study plural sourcing of same inputs are, in fact, studying plural sourcing of very similar inputs. Explicitly accounting for plural sourcing of inputs that are similar, but not exactly the same, may help explain inconsistent empirical findings in plural sourcing research such as the contradicting effects of performance ambiguity on plural sourcing (Heide, 2003; Parmigiani, 2007).

Therefore, we propose to reconceptualize the problematic term *same* into degrees of similarity. Similarity can be conceptualized as a spectrum anchored at one end by identical inputs and extending towards infinite dissimilarity. At a minimum, inputs have to be destined for the same function in the downstream production process to be considered plural sourcing (Parmigiani, 2007). We

expand on Parmigiani (2003) to suggest a partial list of dimensions along which two inputs could be more or less similar. We define an input as a good or service used for the same function in a given stage of a production process (Parmigiani, 2003):

1. Overlap of the scientific/technological basis refers to the possibility that two inputs can perform the same function in the production process but are based on different principles. For example, car engines can work with internal combustion, but also via electricity or hydrogen. The less similar the scientific principles underlying an input are, the more production routines are likely to differ and, hence, the more difficult it will be to switch from one input to another. Also, the more the underlying scientific principles differ, the more the knowledge required to produce/use the input will differ. The less similar the scientific basis, the less likely are losses of economies of scale when production volumes are split among multiple suppliers.
2. Similarity of the production techniques and equipment refers to the possibility to utilize production investments already made to use input A to use input B. The more similar production techniques and equipment are, the more likely are losses of economies of scale if production were to be split across multiple suppliers. The more similar production techniques and equipment are, the quicker and less costly production facilities can be adjusted to use the different inputs. This dimension—the ability to use multiple inputs to produce the same product—contrasts with economies of scope, which is the ability to produce multiple products from the same inputs.
3. Comparability of costs of using different inputs refers to the ability to substitute one input (e.g., sugar) for another (e.g., corn syrup) in the production process while still achieving a given output at a given cost. The greater the cost differences, the less flexibility a firm has to switch from one input to another as the same output can only be produced with higher costs or the output has to be reduced when the cost are kept constant.
4. Comparability of consumer perception of a product made using different inputs refers to the possibility that consumers might not equally value a product that is made using a

different input. Consider as an example the impact of replacing organic food ingredients with nonorganic ingredients.

5. The quality of a product made with different inputs refers to potential differences in quality along dimensions not immediately available to consumers. For example, two different types of fastener might influence the durability of furniture. This difference may have long-term implications, e.g., increased warranty costs, even though customers are initially unaware of the difference.

In judging how similar two inputs are, different dimensions are more important under different situations. For example, for a capital-intensive product, dimensions one and two are probably most important, while for a product with high price sensitivity (e.g., soda), dimension three might be the most important. For a luxury consumer good, dimensions four and five might be most important. Thus, whether procuring two inputs via different modes represents plural sourcing depends on the context-specific managerial decision about which are the most relevant dimension(s) and how similar are two inputs along those dimensions (Tversky, 1977).

We illustrate our logic using an exemplary input to car manufacturing, the engine. Hyundai produces two versions of its Genesis sedan, one with a V6 engine, the other with a V8. If Hyundai procured the V6 and the V8 via different modes, to what degree should we think of this as plural sourcing? Clearly, they are not the same input. However, if they were very similar, much of the logic of plural sourcing would be relevant, and we could usefully consider it an example of plural sourcing. How similar, then, are they? In terms of the scientific principles on which they operate, they are very similar. Both rely on internal combustion of a gas-air mixture.

Both use similar production techniques and equipment. Indeed, both the V6 and the V8 model are built on the same production line (Vasilash, 2008). The cost Hyundai pays for the V8 is likely to be marginally higher. The quality of the end product is unlikely to differ systematically with the engine, and the average consumer's perception of the V6 and V8 sedans are not radically different (Bell, 2009). Overall, the V6 and V8 input represent very similar inputs for

the Hyundai Genesis and could be thought of as potential plural sourcing.

In contrast, compare a V8 internal combustion engine to an engine powered by a hydrogen fuel cell. The relevant scientific principles differ dramatically: a chemical reaction versus combustion. Producing a car using a fuel cell, rather than internal combustion, requires different tools and techniques to protect the fragile fuel cell from vibration and extremes of temperature. Hydrogen fuel cells are much more expensive than internal combustion engines. Consumer perceptions likely differ, with hydrogen cars perceived as “greener,” but less convenient. Quality differences of the end product are yet unknown. So, while several automakers are purchasing fuel cells, it does not seem reasonable to consider the procurement of V6 engines and hydrogen fuel cells via different means as plural sourcing, but rather as simply buying different inputs via different means.

Our reconceptualization addresses the difficulties we identified above. At the most basic level, it is more linguistically precise. Rather than describe nonidentical inputs as the same, we can refer to inputs being more or less similar. Additionally, it provides a more nuanced approach to defining plural sourcing. Lastly, as we will develop in our propositions below, the degree of similarity serves as an explanatory variable in models of plural sourcing. Our approach moves us from debating about whether something is plural sourcing or not to using similarity as an explanatory variable.

Reconceptualizing *how* by recognizing multiple combinations of sourcing modes

The plural sourcing literature has focused overwhelmingly on the combination of make and buy. Other combinations, such as make-and-ally or buy-and-ally, are rarely considered and even more rarely studied in depth. However, the few papers that took a broader view suggest that the other modes appear in sufficient numbers to be managerially and theoretically relevant. For example, Veugelers and Cassiman (1999) found that among innovative Belgian firms that engaged in some form of concurrent sourcing, 33 percent engaged in make-and-buy, 12 percent in make-and-ally, and 55 percent in all three modes. The definitions used in their study rule out observing buy-and-ally. However, the innovation literature

provides evidence for its use, e.g., Boudreau and Lakhani (2009).

Despite evidence regarding the importance of modes beyond make-and-buy, most studies have implicitly either examined only one form of plural sourcing, typically make-and-buy, or considered all forms of plural sourcing to be the same. This limited focus creates four problems.

First, we know little about the actual prevalence of other modes. Studies of make-and-buy are unlikely to reveal the use of other combinations. Second and more worryingly, it risks biasing our interpretation of empirical results. Consider how a survey respondent who produced an input both internally and through an alliance (make-and-ally) could respond to being asked if they made and bought a component. Depending on the definition of make-and-buy provided, he or she might answer that they do not, leading to undercounting of plural sourcing. More problematically, they might answer “yes,” thus conflating alliance relationships with pure market transactions and unintentionally treating heterogeneous plural modes as identical.

Third, it limits our ability to develop and test theory regarding the full range of plural sourcing modes. We submit that, just as each single mode of governance has its own strengths and weaknesses, so does each plural sourcing mode. By ignoring this possibility, the current conceptualization examines an incomplete set of outcomes and may confound findings about plural sourcing in general and its most oft-studied form, make-and-buy.

Lastly, the lack of theoretical development limits our ability to explore the appropriateness of different combinations of modes for a given situation. Thus, we cannot advise managers about their use.

In response, we propose reconceptualizing *how* to include explicitly the full set of potential modes: make-and-buy, make-and-ally, and buy-and-ally. Understanding plural sourcing modes requires that we consider both the properties of each constituent governance mode in isolation and also their interaction. Interaction between the constituent governance modes of a plural sourcing mode can take two forms. First, two modes can augment each other’s strengths. For example, learning from external suppliers can be more effective in the presence of absorptive capacity created by internal production (Parmigiani, 2007). Alternatively, the modes may compensate for each

other's weaknesses. For example, the diminished incentives of internal supply can be partially offset by combining it with external sourcing (e.g., Heide, 2003).

Reconceptualizing *how* as all potential combinations of constituent modes, with each combination encompassing the properties of its constituent modes and their interaction, addresses the above-noted weaknesses of the current conceptualization. It does so by creating a common framework for studies of different plural sourcing modes. We mention three additional implications. First, it suggests a broader framing for research, moving from whether plural sourcing occurs to which form of single or plural sourcing occurs. Second, it calls for research designs that capture more modes of plural sourcing and discriminate appropriately among them. Third, it provides an interface to literatures not yet perceived as informing or informed by the plural sourcing literature, such as the alliance literature.

APPLYING THE RECONCEPTUALIZATION OF PLURAL SOURCING

In this section, we put our reconceptualization of the *what* and *how* of plural sourcing into practice. We develop a set of propositions, summarized in Table 2, that predict the use of plural sourcing and the choice of specific plural sourcing modes as a function of similarity and two dimensions of uncertainty that the literature has identified as predictors of plural sourcing: performance ambiguity and technological volatility. Following much of the literature on plural sourcing, we remain within the transaction cost economics (TCE) tradition.

Importantly, our aim is not to provide an exhaustive explanation of plural sourcing, but to demonstrate how one could apply our reconceptualization and the benefits of doing so. Nevertheless, the propositions we develop are empirically useful and important. More importantly, they illustrate how the enhanced understanding of the trade-offs and synergies among governance modes generated by reconceptualizing plural sourcing generates new theoretical insights (of uncertainty in our case) relevant to governance choice situations beyond plural sourcing itself.

Performance ambiguity

Performance ambiguity occurs when the causes of good or bad performance are not clearly identifiable due to the interplay of bounded rationality and opportunism (Williamson, 1975). Difficulties in measurement (Barzel, 1982) or the nonseparability of effort across actors (Alchian and Demsetz, 1972) may make inputs, outputs, and their relationship difficult to evaluate (Heide, 1994). Ambiguity increases the likelihood of opportunistic behavior since opportunism may go unnoticed when perceptions of behavior are ambiguous (Carson, Madhok, and Wu, 2006; Ouchi, 1980). Also, in situations of ambiguity, cooperative acts may be incorrectly sanctioned as opportunistic, reducing incentives for cooperation (Carson *et al.*, 2006).

Market exchange (buy) is difficult in the presence of performance ambiguity (Wathne and Heide, 2000; Williamson, 1975). Not only is it difficult to establish performance criteria initially, the buyer may be unable to determine when the supplier is acting opportunistically, particularly because it lacks first hand knowledge of the production process (Heide, 2003). In the event of disagreement, third parties such as the courts will find it difficult to ascertain fault (Masten, 1984). For example, Nokia relies heavily on external suppliers, but reports that “*a component supplier may fail to meet our supplier requirements . . . and consequently some of our products are unacceptable to us and our customers, or we may fail in our own quality controls.*” (Nokia, 2003: 16, emphasis added).

Making a component internally mitigates these difficulties, but it is not a complete solution (Alchian and Demsetz, 1972). Williamson (1985) explicitly discussed shirking and inferior performance based on weak incentives within hierarchies. Similarly, as Ouchi (1980: 134) suggested, “Bureaucracies can fail when the ambiguity of performance evaluation becomes significantly greater than that which brings about market failure.”

Alliances as hybrid governance forms, lying between the polar forms of market and hierarchy (Oxley, 1997; Williamson, 1991), also fail to address performance ambiguity.² Alliances depend on social sanctioning mechanisms that are only

² Some broad definitions of “alliance” blur *ally* and *buy* when buying involves repeated market transactions (Mayer and Teece, 2008). We focus on two substantial differences between alliances

Table 2. Optimal governance modes

	Technological volatility		
	Performance ambiguity	Learning	Balancing learning and flexibility
Make	+ Understanding of input characteristics, but weak incentives.	+ Absorptive capacity, but limited access to external information.	- - Limited learning, lowest flexibility.
Buy	- - - Difficult to establish evaluation criteria, detect opportunistic behavior, or use third party dispute resolution.	- - - No absorptive capacity. Market ties weak at transferring and integrating knowledge.	- - Flexibility, but without the learning required to recognize when to act on it or how to do so.
Ally	- - - Difficulty in establishing criteria impedes social sanctioning, small numbers bargaining may create opportunism.	+ Enhanced transfer of knowledge, limited by lack of absorptive capacity.	- Limited learning, low flexibility.
Make and buy	+++ Allows benchmarking, increases internal and external incentives.	++ Absorptive capacity and access to external knowledge, but market ties weak at transferring and integrating knowledge.	++ When relatively little learning is required, loss of flexibility outweighs learning advantages of make. When more learning is required, market ties provide poor access to external knowledge.
Buy and ally	- - Benchmarking impeded by lack of internal knowledge of input characteristics. Diminished incentives for alliance partner.	+ Access to external knowledge, enhanced transfer of knowledge from alliance partner(s), but market ties weak at transferring and integrating knowledge. All learning impeded by lack of absorptive capacity.	+++ (when less learning is required) + (when more learning is required) Preserves flexibility to the greatest degree possible consistent with providing access to at least limited learning required to take advantage of flexibility. Market ties provide flexibility and (relatively ineffective) access to multiple knowledge sources. Enhanced learning from alliance partners provides knowledge required to take advantage of flexibility. Learning is limited since this is only a partial substitute for absorptive capacity, but flexibility is preserved by avoiding internal investments.

Table 2. (continued)

	Technological volatility			Balancing learning and flexibility
	Performance ambiguity	Learning	Flexibility	
Make and ally	++ Allows benchmarking, but with weaker incentives than make-and-buy.	+++ Absorptive capacity, combined with enhanced access to external knowledge.	-- Requires internal investment in potentially obsolescing assets and bureaucracy. Supplements externally with shared investments, albeit within tight relationships.	+++ (when more learning is required) -- (when less learning is required) Absorptive capacity and access to external knowledge from partner maximize knowledge available to recognize when and how to act on flexibility. Comes at cost of reduced flexibility due to internal investments, but supplements externally with shared investments, albeit within tight relationships.

effective when one can determine if one's transaction partner has behaved opportunistically, which cannot be accomplished under high performance ambiguity (Carson *et al.*, 2006; Heide, 2003). Masters *et al.* (2004) strengthened this argument by stating that relational contracting actually increases the risk of opportunism because closer ties create a small numbers bargaining situation without the safety of complete integration (see also Mayer and Teece, 2008).

Hence, in situations of ambiguity, reliance on a single governance form may be insufficient as markets, hierarchies, and alliances each suffer from substantial inefficiencies (Heide, 2003). These inefficiencies result from the difficulty of objectively measuring the input and/or the output of a production process. As Heide (2003) shows, firms solve these inefficiencies not by establishing multiple market relationships, but by shifting from exclusive reliance on market transactions to plural sourcing. Plural sourcing allows benchmarking one output with another one and can help address performance ambiguity (Heide, 2003). Further, it may supplement output measurement with behavior controls and/or socialization processes (Heide, 1994). Two plural modes can counteract each other's weaknesses. However, combinations of modes differ in their effectiveness.

Reliably assessing performance of an input requires the firm to have knowledge about the input. This favors inclusion of "make," which generates understanding and knowledge about the characteristics of an input (Grant, 1996; Kogut and Zander, 1992). However, as hierarchies suffer from weak incentives, monitoring compliance with performance objectives may be costly and inefficient.

Markets counteract weak incentives, filling the incentive gap posed by *make*. By combining making and buying, a firm increases incentives for both internal and external suppliers by maintaining a credible threat of switching to the better performing supplier when necessary (Du, Lu,

and market-based supplier relationships, even very long-term supplier relationships with highly specific investments such as in jet engines (Mayer and Teece, 2008). First, alliances entail a more detailed administrative structure, more joint decision making, are more difficult to terminate, and thus harm flexibility. Second, alliances are more likely to involve two-way information sharing and thus benefit learning—defined as either the transfer of knowledge from one organization to another or the creation of new knowledge through interaction among organizations (Larsson *et al.*, 1998).

and Tao, 2006). Samsung's liquid crystal display (LCD) business provides an example: "Samsung often forces its own units to compete with outsiders to get the best solution ... Samsung buys half of its color filters from Sumitomo Chemical Co. of Japan and sources the other half internally, pitting the two teams against each other. 'They really press these departments to compete.'" (Edwards, Ihlwan, and Engardio, 2003: 18).

Combining making and buying also decreases the risk of opportunism by filling the knowledge gap left by buying alone (Dutta *et al.*, 1995; Heide, 2003). As Brusoni, Prencipe, and Pavitt (2001) suggest, some firms develop expertise without internal production. However, evidence for the benefits of expertise from internal production when benchmarking is strong (Heide, 2003). Combining benchmarking with internal understanding of performance drivers makes a firm more likely to detect opportunistic behavior (Harrigan 1984). As stated by Parmigiani (2003: 200), "Having both internal and external streams of information about the input reduces the problems associated with monitoring quality." Lincoln, Ahmadjian, and Mason (1998: 252) captured these benefits in their study of Toyota, "The primary reason that Toyota desires the capability to develop and produce the same electronic components and subassemblies that it sources from Denso and other suppliers is that Toyota cannot otherwise evaluate what it is purchasing."

Plural sourcing modes that include alliances fall short in addressing performance ambiguity, as alliances fill neither the knowledge nor incentive gaps left by *buy* and *make*, respectively. As a supplement to *make*, ally is inferior to buy in the presence of performance ambiguity. Given the knowledge developed through internal production, the firm does not need the learning advantages of an alliance. Benchmarking provides a means of constraining opportunism that does not rely on the governance advantages of an alliance. Indeed, the contractual commitments present in an alliance diminish the value of benchmarking by limiting the firm's flexibility to act upon poor performance. As a supplement to *buy*, alliances cannot substitute for internal production in creating the knowledge needed for benchmarking. Hence, we derive the following proposition:

Proposition 1: Performance ambiguity is most strongly associated with make-and-buy.

The ability to benchmark performance increases with increasing similarity of inputs. Comparing identical inputs provides the best grounds on which to identify differences between inputs and/or outputs of production. Differences in output performance may be identified using, for example, relative performance tests in laboratories or in the field. Internal understanding about the characteristics and production process of an input allows the firm to trace back the origin of potential performance differences and to evaluate whether performance differences are based on opportunism (Dutta *et al.*, 1995; Harrigan, 1984). Similarity in consumer perception enables comparison of goods and services with which end users interact intensively. This is exemplified by Samsung's above-mentioned plural sourcing of color filters, which are very similar in all five dimensions (Edwards *et al.*, 2003).

However, as inputs become less similar, it becomes more difficult to identify the source of performance differences because the inputs and/or outputs are not directly comparable. Comparing less similar inputs to reduce ambiguity bears the risk of not identifying opportunism or incorrectly sanctioning nonopportunistic behavior. Hence, the ability of plural sourcing to reduce performance ambiguity increases with increasing similarity of inputs, as summarized by Proposition 2:

Proposition 2: Performance ambiguity is associated with plural sourcing of more similar inputs.

Technological volatility

Technological volatility refers to the rate and unpredictability of future development of technologies and occurs when the future development of technologies cannot be assessed *ex ante* due to bounded rationality (Balakrishnan and Wernerfelt, 1986; Carson *et al.*, 2006). In many markets, only a single or few technological standards survive. Firms that fail to ensure access to or compatibility with the dominant technological standard risk being locked out of the market (Schilling, 1998) and losing the value of now obsolete investments (Balakrishnan and Wernerfelt, 1986). Thus, technological volatility creates the need for flexibility—the ability to do new things quickly (Schilling and Steensma, 2001: 1151)—to adapt to technological change once a dominant technological standard is (about to be) selected (Schilling, 1998).

Were this the only concern, the choice of mode would be easy—buying from the market preserves maximum flexibility. However, technological volatility also requires the firm to learn about diverse technological trajectories. Flexibility is useless if the firm lacks knowledge about the various technological developments under way. An uninformed firm can neither evaluate the likely future of competing technological approaches, nor determine whether and when change may be required. Additionally, if the firm does not have at least some basis in the ultimately dominant technology, it risks technological lock-out (Schilling, 1998). Thus, the firm must preserve as much flexibility as it can, consistent with achieving enough learning to act upon that flexibility.

The single modes all fall short when it comes to achieving this balance. Making provides absorptive capacity, but weak access to external knowledge—crucial since many of the potentially dominant technologies will be developed at other firms (Powell, Koput, and Smith-Doerr, 1996; Sørensen and Stuart, 2000). Additionally, making is the least flexible option due to bureaucracy and investments in potentially obsolescing assets (Balakrishnan and Wernerfelt, 1986). Buying preserves flexibility, but offers little opportunity to learn. The firm lacks absorptive capacity, and market ties transfer and integrate knowledge poorly because coordination and cooperation is limited (Gulati and Puranam, 2006). Indeed, firms often take steps to limit learning by their exchange partners. Alliances provide better learning since they align incentives and coordinated resource exchange (Dyer and Nobeoka, 2000; Khanna, Gulati, and Nohria, 1998). However, a firm relying solely on alliances would have only a shallow pool of relevant internal knowledge, which would impede learning (Grant, 1996). Alliances enhance flexibility by sharing the costs of potentially obsolescing investments (King, Slotegraaf, and Kesner, 2008), but each participant still must make substantial investments that may be rendered obsolete by technological change. Additionally, alliances require managerial attention and the development of relationship-specific routines for coordination and governance. Thus, alliances are difficult and costly to unwind rapidly in the face of change (Williamson, 1991). Next, we turn to plural modes. Because of the benefits discussed above, we posit that the ally option will be part of the

solution. It provides better learning than buying, while preserving more flexibility than making.

Proposition 3: Technological volatility is most strongly associated with plural sourcing that includes allying.

The appropriate complement to *ally* depends on how much learning is required. If a fairly shallow amount of learning is sufficient, buy-and-ally is optimal. Buying provides flexibility and access, albeit not very effective, to multiple sources of external knowledge. The alliance provides enhanced access to at least one source of external knowledge and enhances learning by providing a partial substitute for absorptive capacity. Learning is deeper and broader than either ally or buy alone, while preserving flexibility by avoiding internal investments. Boudreau and Lakhani (2009) provide the example of Topcoder.com, which combines buying (through competitions for prize money) the services of over 180,000 developers with close collaborative arrangements with selected developers (alliance-like).

Proposition 3a: Technological volatility is most strongly associated with buy-and-ally when relatively little learning is required.

In other cases, this may not provide sufficiently deep and/or broad learning for the firm to take advantage of flexibility. In these cases, the need for absorptive capacity requires the make option, despite its negative impact on flexibility. Combining make with ally increases learning by pairing absorptive capacity from make with enhanced external learning from the alliance (Lane and Lubatkin, 1998), and partially offsets the negative impact on flexibility by allowing the firm to “hedge its bets” on another technological approach without making the full investment itself. For example, Sun Microsystems combines alliance-like ties with key external suppliers and internal development of new technologies because it wants multiple options in the face of technological volatility, but still needs deep understanding of the technologies involved (Farlow *et al.*, 1996).

Proposition 3b: Technological volatility is most strongly associated with make-and-ally when more significant learning is required.

In contrast to performance ambiguity, plural sourcing becomes less useful as a means of addressing technological volatility as the inputs being sourced become more similar. Technological volatility requires that firms learn about multiple competing technological trajectories. Only by doing so can the firm monitor developments along each, compare their progress, and be prepared to pursue the trajectory that ultimately dominates (Schilling, 1998). Plural sourcing of very similar inputs leads instead to learning about a narrow range of related technologies. Similarly, plural sourcing of very similar inputs provides minimal flexibility, since developments rendering one obsolete are likely to render the other obsolete as well. Rather than hedging its bets, the firm would have increased its bet on a narrow subset of the technological outcomes. In contrast, sourcing less similar inputs enables the firm to diversify the risk of obsolescence (Henderson and Cockburn, 1996; King, Slotegraaf, and Kesner, 2008).

The strategies of Japanese flat panel display makers in the early 2000s provide an empirical example of our proposition. In the face of technological volatility, Japanese firms combined internal development and joint ventures around different technologies such as LCDs and plasma, which were dissimilar in technological bases and performance characteristics (Boyd, 2004).

Proposition 4: Technological volatility is associated with plural sourcing of less similar inputs.

DISCUSSION

We have reconceptualized two aspects of plural sourcing in order to resolve some of the strains between existing plural sourcing studies and to lay a more theoretically consistent foundation for examining plural sourcing. Both reconceptualizations have important implications for theory, empirical research, and managerial practice.

First, we have reconceptualized the *what* of plural sourcing to clarify what actually represents plural sourcing. We have done so by conceptualizing plural sourcing not as sourcing the same input via multiple modes but as sourcing more or less similar inputs. From a theory perspective, this moves the discussion from whether a situation is really plural sourcing and allows us to explore how similarity affects the ability of plural sourcing modes

to address different governance problems. As a step towards applying this reconceptualization, we have provided empirically relevant dimensions of similarity of inputs to improve and develop measurement of plural sourcing. As a managerial implication, we have been able to predict the role of similarity in inducing plural sourcing, as similarity determines the degree to which plural sourcing enables monitoring, learning, and flexibility.

Our reconceptualization of the *how* of plural sourcing specifies a fuller range of possible governance mode combinations in plural sourcing. Importantly, we have done so not by merely widening the definition of plural sourcing, but by considering each combination's unique characteristics. This reconceptualization provides an overarching framework for studies of different plural sourcing modes. Additionally, it provides the foundation for more theoretically and empirically nuanced consideration of the relative benefits of each mode in specific circumstances. It connects to our first reconceptualization by specifying which sourcing mode combinations best allow addressing different governance problems.

We have illustrated the application of our reconceptualization to situations of technological volatility and performance ambiguity. However, this is just one application, and we see linkages to several ongoing lines of inquiry, both within plural sourcing literature and more broadly. We have not explored economies of scale, an important determinant of plural sourcing, at length. On the one hand, splitting production of an input across multiple modes limits economies of scale. On the other hand, if an external supplier aggregates demand across multiple buyers, plural sourcing may allow a firm to benefit from the scale economies for part of its production without becoming wholly dependent on that supplier. Similarity in the dimensions of technological basis and production techniques plays a role in each case. The more similar the inputs, particularly in terms of production technology, the greater the potential economies of scale lost by splitting production—lower similarity means fewer scale economies available in the first place. Similarity in other dimensions can be unrelated to scale economies. For example, sugar and corn syrup may be similar in cost, consumer perception, and quality, but do not offer economies of scale if sourced from a single source. Similarly, technological volatility may have differing effects

over the dimensions of similarity. For example, production equipment may be more affected than customer perceptions.

Continuing this logic, we note a link to Parmigiani (2007), who proposed that different factors motivate the decision to engage in plural sourcing versus amount procured via each mode. While we have focused on the first decision, our reconceptualization has implications for the second decision also. For example, Parmigiani posited that increasing asset specificity leads to a larger proportion of internal production as a safeguard against potential hold-up. Our reconceptualization of *how* suggests that lower similarity between internally and externally sourced inputs reduces the ability to replace external production with internal production, weakening the relationship between asset specificity and the proportion of internal production. Thus, our reconceptualization introduces an additional consideration, as the decision criteria for percentages within one plural mode may differ from the criteria for another.

Not all sourcing modes are feasible for all firms. For example, firms lacking attractive resources may not find alliance partners (Ahuja, 2000) or they do not have the option to ally due to the lack of managerial resources to set up the administrative structure. A desire to preserve proprietary knowledge may discourage buying and allying. In addition, smaller firms, such as Parmigiani (2007) studied, may not need to complement making with buying, since internalization likely leads to less loss of incentives and difficulties in monitoring. Veugelers and Cassiman's (1999) finding supports this: smaller firms were less likely to engage in plural sourcing than larger firms.

Our reconceptualization supports efforts to complement TCE with the capabilities literature to explain plural sourcing (Parmigiani and Mitchell, 2009). For example, firms can build capabilities via plural sourcing (Parmigiani, 2007), subject to the similarity of the inputs being sourced. Too much similarity means there will be little to learn, while too little similarity limits learning because the firm will have less relevant absorptive capacity (c.f. Mowery, Oxley, and Silverman, 1996). We also draw attention to the value of both make-and-buy and make-and-ally as a means of building capabilities.

More broadly, this paper contributes to a more detailed understanding of governance choice and governance combinations in general. We highlight

the different ways in which governance mode combinations work depending on the type of governance problem at hand, sometimes compensating for each other's weaknesses, other times augmenting each other's strengths. A more nuanced study of how governance modes interact represents an interesting path for future research.

Integrating our reconceptualization into empirical research begins with *what*, that is, determining the most relevant dimensions of potential similarity. The next step is to develop a measurement scale for how similar inputs are along those dimensions. For example, substitutability of production inputs is a useful heuristic to classify the degree of similarity (Parmigiani, 2003). Substitutability describes the ease with which one input to production can be substituted for another one. The better one input can be substituted for another input, the more similar the inputs are. The last step is to develop a weighting scheme among the dimensions, which may be driven by data, theory, or a mixture of the two. While we have offered recommendations on each step, a rich understanding of the empirical setting is essential to account for context-specific differences in individual managerial perceptions of similarity. Expanding the full set of potential governance choices (*how*) begins with determining the governance challenges to be overcome. The next step is to consider the degree to which each single governance mode addresses them. If significant challenges are left unaddressed by any single governance mode, consideration turns to what combination of governance modes will more completely address the challenges. The optimal plural sourcing mode may or may not include the optimal single governance mode.

As a field, our understanding of plural sourcing has grown tremendously over the last several years. That growth has led to a somewhat disparate set of definitions, theoretical assumptions, and empirical findings. We hope that our reconceptualization will help unify the insights that have been generated, while laying the foundation for future work.

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