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Revisiting Tradeoffs in Manufacturing Strategy: A Fuzzy Set Approach for Developing a Typology of Competitive Priorities

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Abstract

In this paper, we adapt and extend the core-peripheral perspective of typology proposed by Fiss (2011), and propose a typology structure consisting of three conditions, namely, necessary, core, and peripheral conditions. We develop a structured typology of manufacturing strategy based on Miles and Snow (1978)'s typology of organizational strategy and utilize the newly emerging FsQCA methodology to identify necessary, core, and peripheral conditions in typology. The analysis of 434 Chinese manufacturers shows that configurations of competitive priorities that are consistent with the Miles and Snow (1978)'s typology can lead to excellent organizational outcomes.

Keywords: Fuzzy Set, Manufacturing Strategy, Competitive Priorities, Typology, Tradeoff

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Introduction

Manufacturing strategy is the pattern of manufacturing choices that a company makes, which allows it to compete in the marketplace (Miller and Roth, 1994). In order to achieve satisfactory performance, managers need to formulate a manufacturing strategy by choosing between various competitive priorities, such as quality, cost, flexibility, and delivery, etc. They need to emphasize some, but not all of the priorities (Rosenzweig and Easton, 2010), based on their business strategies (e.g., Barnes, 2002; Skinner, 1969; Ward and Duray, 2000). Given the foregoing, various manufacturing strategies exist.

To classify these manufacturing strategies, researchers have previously developed various taxonomies of competitive priorities (e.g., Frohlich and Dixon, 2001; Kathuria, 2000; Miller and Roth, 1994; Sum et al., 2004; Zhao et al., 2006). Despite their efforts, several gaps exist in literature. First, these taxonomies differ greatly from each other. Their generalizability is thus questionable. Second, since the taxonomies are empirically derived, there is a lack of suitable explanations as to why a particular operations strategy is effective or ineffective. Finally, within these taxonomies, all priorities as regarded as equally important. This traditional approach, however, is problematic. A particular manufacturing strategy may comprise priorities with differing levels of importance: Some priorities are essential to the success of the strategy, while others are less important (Fiss, 2011). To date, researchers have not distinguished such differences among the priorities included in manufacturing strategies.

To address the aforementioned issues, we develop a theory-driven, structured typology of competitive priorities in this study. We first extend the core-periphery perspective of typology posited by Fiss (2011), and propose a typology structure consisting of three types of conditions with different levels of importance in relation to organizational outcomes, namely, necessary, core, and peripheral conditions. Next, based on Miles and Snow (1978)'s classical typology of business strategy, we identify three manufacturing strategies, namely *prospector*, *analyzer*, and *defender*. Each strategy consists of priorities that constitute necessary, core, and peripheral conditions for organizational outcomes. Finally, we empirically test the validity of our structured typology of competitive priorities by employing a newly emerged technique known as fuzzy set qualitative comparative analysis (FsQCA) (Ragin, 2000; 2008), which enables researchers to model causal relationships in terms of set-theoretic relations (Fiss, 2011). In doing so, we establish a direct linkage between manufacturing strategic types and organizational outcomes.

Literature Review

Miles And Snow (1978)'S Business Strategy Typology and Manufacturing Strategy

In this study, we adopt Miles and Snow (1978)'s classical typology of business strategies. Miles and Snow (1978) classify businesses according to management's *strategic intentions* and offer a framework on how various aspects of structure, processes, and management style should fit together under each type of strategy (Walker and Ruekert, 1987). Since the current study focuses on firms' *intentions* to pursue various competitive priorities at the operational level, this typology could serve as a theoretical framework linking operations strategy to business strategy.

Specifically, Miles and Snow (1978) propose three major strategic groups, referred to as "prospector", "analyzer", and "defender", in addition to a residual group labeled "reactor", which consists of firms that lack a coherent strategic-structure relationship. Among the three groups, prospectors are typically growing organizations, which are technically innovative and are seeking out new markets; defenders are established firms focusing on maintaining a secure market share, which stay within a limited range of products and emphasize resource efficiency and process improvement (Desarbo et al., 2005; Fiss, 2011; Miles and Snow, 1978). Analyzer falls between the two extremes; notably, they make fewer and slower product/market change than prospectors, and are less committed to stability and efficiency than defenders (Hambrick, 1983; Miles and Snow, 1978).

Importantly, Miles and Snow (1978)'s three types of business strategies differ substantially in terms of their choices related to the market domain, engineering technologies, and organizational structure, infrastructure, and policy processes (Conant et al., 1990; Miles and Snow, 1978). In every market where a firm chooses to compete, there is a set of market-based criteria for success, which demands differing emphases on competitive priorities (Voss, 1986). As such, different business strategies require different sets of manufacturing capabilities, and correspondingly, different manufacturing strategies.

A Structured Perspective of Typology

A typology consists of multiple ideal types, each of which represents a unique combination of organizational attributes that are believed to determine the relevant outcome(s) (Doty and Glick, 1994). Traditionally, researchers often implicitly assume that the organizational attributes included in a typology are equally important. This approach, however, is fundamentally problematic and may limit understanding of relevance and importance of the attributes to desirable outcomes (Fiss, 2011). Fiss (2011) thus proposes a core-periphery perspective of typology, with the core attributes being essential, while the peripheral ones are less important and perhaps even expendable or exchangeable. In this paper, we extend Fiss (2011)'s perspective, and propose a typology structure consisting of three elements, namely, 'necessary, core, and periphery' conditions.

We will start with a simple, hypothetical example to illustrate the proposed typology structure. The Association to Advance Collegiate Schools of Business (AACSB) required business schools to recruit professors who are either academically qualified or professionally qualified. Thus, there are two different groups of individuals who are qualified for faculty jobs in AACSB accredited business schools. Assume that these business schools always recruit professors in the supply chain management (SCM) area, adhering to these rules:

1. A successful candidate *must* have obtained his/her final degree from an AACSB accredited business school.
2. A successful academically qualified candidate *must* hold a doctoral degree in SCM or related fields.
3. A successful professionally qualified candidate *must* hold a master degree in SCM or related fields.
4. A successful professionally qualified candidate *must* have work experience related to SCM.
5. A Certified Professional in Supply Management (CPSM) certificate from the Institute for Supply Management is *preferred* for a professionally qualified candidate.
6. Work experience is *preferred* for an academically qualified candidate.

Among these rules, rule No.1, obtaining final degree from an AACSB accredited business school, is a must-have for all candidates, regardless of which group they belong to. Thus, it is a necessary condition for an individual to be recruited. More formally, we define a *necessary condition* in a typology as a condition required for all ideal types to achieve a desirable outcome. Rule No. 2, holding a Ph.D in SCM is a must-have for academically qualified candidates; Rules No. 3 and 4, holding a Master degree and having work experience, are must-have for professionally qualified candidates. These are thus core conditions for their respective groups. More formally, we define a *core condition* in a typology as a condition that is required for members in one particular ideal type to achieve a desirable outcome. The combination of core conditions defines the membership of an ideal type, as all members in this group share the same core conditions. Finally, rule No. 5, holding a CPSM certificate, could increase the chances for a professionally qualified candidate to be recruited; rule No. 6, having work experience, could increase the chances for an academically qualified candidate to be recruited. However, a candidate without these conditions will *not* be disqualified and can still compete in their respective groups. These are *peripheral conditions* for the two groups. More formally, we define a *peripheral condition* in a typology as a condition that can facilitate desirable outcomes for a particular ideal type, but does not define the membership of the ideal type. The structure of this hypothetical typology is shown in Table 1.

Table 1: A Hypothetical Typology of SCM Professor Recruitment

	Academically qualified candidate	Professionally qualified candidate
Necessary condition	Final degree from an AACSB accredited business school.	
Core conditions	A doctoral degree on SCM or related fields.	A master degree on SCM or related fields. Work experience related to SCM
Peripheral conditions	work experience related to SCM	A Certified Professional in Supply Management (CPSM) certificate from Institute for Supply Management

Developing a Structured Typology of Competitive Priorities

Researchers generally agree that competitive priorities pertaining to four major types of capabilities, such as costs, quality, delivery, and flexibility, constitute the basic components of a manufacturing strategy (Frohlich and Dixon, 2001; Miller and Roth, 1994; Rosenzweig and Easton, 2010; Ward et al., 1995; Zhao et al., 2006). Consistent with this view, we include the following competitive priorities in our typology: *costs*, *quality*, *delivery*, *broad product line*, as well as *volume* and *design flexibility*. Among them, the last three priorities are often regarded as sub-dimensions of flexibility (Frohlich and Dixon, 2001). However, they are related to different strategic problems. Specifically, *broad product line* at the operational level is determined by a firm's definition of product-market domain; *design flexibility* is required if a firm's business strategy is to aggressively seek new market opportunities rather than cautiously stay within its existing domains; and a firm may develop *volume flexibility* in response to environment uncertainty and fluctuation of demands. With this in mind, we discuss the three sub-dimensions of flexibility separately.

In the following sections, we will identify the competitive priorities that constitute necessary, core, and peripheral conditions for the three ideal types to achieve desirable performance outcomes. We define the necessary and core condition based on Miles and Snow's theory, as well as prior literature on manufacturing strategies. The remaining priorities, with their presence or absence not stipulated by theory, should constitute peripheral conditions for the outcomes. The rationale is that, while these priorities are not essential for firms to pursue a particular strategy, development of capabilities related to these priorities should generally enhance a firm's competitiveness in the marketplace.

In this paper, the primary organizational outcomes of interest are sales growth and profitability, which have been widely tested as outcomes in studies on Miles and Snow typology (e.g., Desarbo et al., 2005; Hambrick, 1983; Moore, 2005; Parnell and Wright, 1993; Smith et al., 1989), as well as in studies on manufacturing strategies (e.g., Amoako-Gyampah and Acquaah, 2008; Sum et al., 2004; Ward and Duray, 2000; Zhao et al., 2006). An illustration of the proposed typology is presented in Table 2.

Table 2: Necessary and Core Conditions for Proposed Manufacturing Strategy Typology

	Prospector	Defender	Analyzer
Quality	N	N	N
Delivery	P	C	C
Cost efficiency	~C	C	C
Volume flexibility	C	~C	P
Design flexibility	C	P	P
Broad product line	P	~C	C

Note: N- necessary condition; C-core condition; P-peripheral condition; ~absence of the condition.

Quality as a Necessary Condition

Among all competitive priorities, quality is unique in that it has been widely regarded as essential to business outcomes by several groups of researchers; further, its importance across strategic groups is supported by strong empirical evidence. First, researchers have commonly showed that a *precondition* of all lasting improvement in manufacturing capabilities is the improvement in quality performance (e.g., Amoako-Gyampah and Meredith, 2007; Avella et al., 2010; Hallgren et al., 2011; Noble, 1995; Rosenzweig and Roth, 2004; Roth, 1996). These findings imply that quality is a necessary condition for the development of other capabilities, and eventually, a necessary condition for satisfactory business outcomes.

Similarly, another group of researchers have argued that quality should be regarded as a qualifying criterion, such that a company must meet the requirement of quality for a customer to even consider the company as a possible source of supply (Hallgren et al., 2011; Hill and Hill, 2009; Hörte and Ylinenpää, 1997). If the firm does not meet the necessary quality standards, it will lose the order and most likely also potential future orders (Hörte and Ylinenpää, 1997). As such, quality is required for firms to enter or remain in the market, and it also corresponds to the basic needs of customers (Hallgren et al., 2011).

Additional empirical evidence can be found in the studies on manufacturing strategy taxonomies. Close examination of their findings shows that quality dimensions generally receive high emphasis across different strategic groups (Frohlich and Dixon, 2001; Kathuria, 2000; Miller and Roth, 1994; Zhao et al., 2006). Similarly, Conant et al. (1990) show that firms falling into the three strategic groups of the Miles and Snow typology all preferentially emphasize quality. These findings indicate that quality is essential for different business and manufacturing strategies.

Therefore, based on the aforementioned theoretical models and empirical findings, we maintain that quality is a necessary condition for achieving satisfactory organizational performance, across different strategic groups.

H1a: An emphasis on the competitive priority of quality is a necessary condition for a firm to achieve high sales growth.

H1b: An emphasis on the competitive priority of quality is a necessary condition for a firm to achieve high profitability.

Prospector Manufacturing Strategy

The prospectors usually compete by anticipating new product or marketplace opportunities and through technological innovation (Desarbo et al., 2005). In order to succeed, prospectors need to develop new technologies, products, and markets rapidly (Conant et al., 1990). Prospectors greatly emphasize flexibilities (Miles and Snow, 1978). Strength in product R&D and product engineering are essential for firms in this strategic group (Hambrick, 1983; Walker et al., 2003). Under these conditions, *design flexibility*, is required (Conant et al., 1990). Specifically, R&D departments need to focus on developing new products for both existing and new marketplaces. Their technological systems must be designed to avoid long-term commitments to a single type of technological process, and design flexibility is the basis that facilitates new product development (Oltra and Flor, 2010). Furthermore, *volume flexibility* is also required, since prospectors often face an uncertain market (Desarbo et al., 2005), where customer demands may greatly fluctuate. They may also need to dramatically increase the volume of production if a new market opportunity is identified, and decrease the volume if they decide to withdraw from a market.

On the other hand, prospectors generally *do not* emphasize *cost efficiency*. They need to expend a substantial amount of resources on R&D, in order to achieve satisfactory outcomes (Walker et al., 2003). They also attempt to avoid committing to a single technological process, thereby leaving all their options open when faced with new market opportunities (Oltra and Flor, 2010). Thus, they need to utilize more general-purpose equipment, rather than specialized ones, which would allow them maximum flexibility in terms of producing different products. Such equipment, however, is inevitably less cost efficient, compared to specialized equipment (Jelinek and Burstein, 1982). Furthermore, they need to engage a considerable portion of their core technology in production of prototypes, as well as in development of diverse technologies and skills of their technical personnel (Conant et al., 1990; Oltra and Flor, 2010). This also increases their costs. In sum, prospectors need to maintain maximum flexibility in terms of product design and production, which often results in high cost (Miles and Snow, 1978). An emphasis on cost efficiency is, thus, inconsistent with the prospector strategy.

The remaining priorities, such as delivery and broad product line, constitute peripheral conditions, inasmuch as development of capabilities related to these priorities should further enhance prospectors' competitiveness. Thus, it is hypothesized that:

H2: There is a group of firms whose manufacturing strategies are consistent with the profile of prospectors such that the emphasis on competitive priorities of
(a) volume flexibility,
(b) design flexibility, as well as *absence* of emphasis on
(c) cost efficiency, are core conditions for them to achieve high sales growth, while emphasis on competitive priorities of

(d) delivery and
(e) broad product line are peripheral conditions for them to achieve high sales growth.

H3: There is a group of firms whose manufacturing strategies are consistent with the profile of prospectors such that the emphasis on competitive priorities of
(a) volume flexibility,
(b) design flexibility, as well as *absence* of emphasis on
(c) cost efficiency, are core conditions for them to achieve high profitability, while emphasis on competitive priorities of
(d) delivery and
(e) broad product line are peripheral conditions for them to achieve high profitability.

Defender Manufacturing Strategy

Unlike prospectors, the defenders do not emphasize new product or market development. They tend to offer a more limited range of products or services, and try to protect their domains by offering higher quality, superior service, and lower prices (Desarbo et al., 2005; Hambrick, 1983). Thus, their operational functions focus on only a few core technologies (Conant et al., 1990), and *do not* intend to develop and maintain *broad product line.* The defenders' primary goal is to serve a stable market that absorbs the organizations' output on a continuous and high volume flow (Oltra and Flor, 2010). There is little need for defenders to develop *volume flexibility*. Emphasis on the *volume flexibility* in this case, may become a waste of organizational resources.

In contrast, defenders tend to use their resources very efficiently, and they place great emphasis on improving even further their potential for efficiency (Hambrick, 1983). For operations functions, the efficiency could be achieved by pursuing two priorities, such as *cost efficiency* and *delivery*. Specifically, defenders heavily devote themselves to the engineering task, focusing more on resource efficiency and process improvements that cut operations costs (Desarbo et al., 2005; Hambrick, 1983). In addition to *cost efficiency*, *delivery* is also essential. Speedy delivery not only reduces inventories, but also shortens internal product transport time, whereas reliable delivery eliminates the need for repeat consignments (Avella et al., 2011). Furthermore, emphasis on delivery is consistent with the goal of defenders to offer superior service (Desarbo et al., 2005; Hambrick, 1983). Empirically, it is found that defenders should place more emphasis on *cost efficiency* and *delivery* in order to achieve satisfactory performance (Oltra and Flor, 2010). These two priorities thus constitute core conditions for defenders to achieve high performance.

Finally, while design flexibility is not essential to the success of defenders, emphasis on this priority could potentially enhance their competitiveness. Historically, if a firm focuses on cost efficiency, its production process should be designed to handle mass production with low product variety. In this case, it is costly to modify a production line for new products, thus the firm should not frequently introduce new products and/or change product design. Design flexibility should not be emphasized. However, modern engineering technologies, such as Advanced Manufacturing Technology (AMT), and modern management techniques, such as Toyota Production System (TPS), could enable firms to achieve speedy new product introduction and/or design change, without much sacrifice of productivity (Adler et al., 1999; Gerwin, 1993). Thus, it is possible for defenders to also emphasize and develop capability of design flexibility to gain competitive advantages. It could constitute a peripheral condition for defender's performance.

H4: There is a group of firms whose manufacturing strategies are consistent with the profile of defenders such that the emphasis on competitive priorities of
(a) cost efficiency,
(b) delivery, as well as *absence* of emphasis on
(c) broad product line and
(d) volume flexibility, are core conditions for them to achieve high sales growth, while emphasis on competitive priorities of
(e) design flexibility is a peripheral condition for them to achieve high sales growth.

H5: There is a group of firms whose manufacturing strategies are consistent with the profile of defenders such that the emphasis on competitive priorities of
(a) cost efficiency,
(b) delivery, as well as *absence* of emphasis on
(c) broad product line and
(d) volume flexibility, are core conditions for them to achieve high profitability, while emphasis on competitive priorities of
(e) design flexibility is a peripheral condition for them to achieve high profitability.

Analyzer Manufacturing Strategy

Miles and Snow (1978)'s theory suggests a continuum in which the prospector and the defender are endpoints and the analyzer is the midpoint (Doty et al., 1993; Hambrick, 1983). Analyzers engage in two types of product-market domains, with one being relatively stable and another relatively dynamic. They operate routinely and efficiently in a relatively stable market, while watching competitors closely for new ideas in the relatively dynamic market and are ready to produce new products if they appear to be promising (Zajac and Shortell, 1989). Analyzers should thus exhibit some characteristics similar to both prospectors and defenders (Doty et al., 1993). In their relatively stable market segments, analyzers should act like defenders, focusing on efficiency. In their relatively dynamic market segments, they are more likely to follow a second-but-better strategy (Desarbo et al., 2005). Specifically, they enter markets later than the prospectors, with more cost-effective or value oriented products or service offerings (Conant et al., 1990). Accordingly, we maintain that operations functions in an analyzer organization should emphasize the capability of developing and maintaining a *broad product line*, since they are continuously seeking new marketplaces and are acting as calculated followers to prospectors. They are also pursuing efficiency, since they not only need to compete on efficiency in stable markets, and but also intend to offer a "cost-effective or value-oriented product or service" in dynamic markets where they are "second-in". As such, their operations function should emphasize both *cost-efficiency* and *delivery*, as in the case of defenders. These three priorities constitute core conditions for analyzers to achieve high performance.

On the other hand, volume and design flexibility might help them to compete in the marketplace, but they are *not* as critical as aforementioned priorities. The analyzers develop new products or enter new markets only after the products/markets have been proved viable. As such, they may face a relatively stable market demand, compared to those firms entering the market first. This reduces the importance of *volume flexibility*. The design of the new products may have been at least partially defined. Thus, analyzers can update the product line without incurring the prospector's extensive research and development expenses (Oltra and Flor, 2010), which reduce the importance of *design flexibility*. Oltra and Flor (2010) show empirically that volume and design flexibility are not as important for analyzers as for prospectors. Thus, they should constitute peripheral conditions, but not core conditions for analyzers to succeed.

H6: There is a group of firms whose manufacturing strategies are consistent with the profile of analyzers such that the emphasis on competitive priorities of
(a) cost efficiency,
(b) delivery, and
(c) broad product line are core conditions for them to achieve high sales growth, while emphasis on
(d) volume and
(e) design flexibility are peripheral conditions for them to achieve high sales growth.

H7: There is a group of firms whose manufacturing strategies are consistent with the profile of analyzers such that the emphasis on competitive priorities of
(a) cost efficiency,
(b) delivery, and
(c) broad product line are core conditions for them to achieve high profitability, while emphasis on
(d) volume and
(e) design flexibility are peripheral conditions for them to achieve high profitability.

Research Method

Data collection

We investigate our research hypotheses in the context of Chinese manufacturing firms. Our sampling frame consists of 143,000 Chinese companies, each with annual revenues of more than 5 million RMB (Chinese currency). The target companies were randomly selected from 29 Chinese provinces, using a stratified probability proportional to sizes method, which ensures sample representativeness in terms of revenues, industries, and ownership. Budget constraints limited the number of target firms to 620. In each firm, a manager or senior executive familiar with manufacturing served as the key informant; these informants were first contacted by telephone to solicit their cooperation. After the questionnaires had been mailed, we repeatedly called the respondents to remind them to complete and return the questionnaires. With a final response rate of 70%, we obtained questionnaires from 434 firms that represent a range of industries in the manufacturing sector, including electronics and other electrical equipment and components (12.2%), industrial and commercial machinery (12.5%), primary metals and fabricated metal products (except machinery and equipment) (9.7%), chemicals and allied products (10.4%), food and beverage products (10.8%), rubber and miscellaneous plastics products (2.1%), apparel (2.8%), textile (3.9%), paper (2.1%), tobacco (2.8%), medical products (5.5%), and others (25.2%). Among them, 19% employed a work force of fewer than 200 employees, 16% had 200–500, 34% employed 500–2000, and 30% had more than 2000 employees. Regarding ownership, 35% of the companies were state-owned enterprises (SOEs), and 65% were non-SOEs.

Measurement Development

We adopted the measures of competitive priorities from Miller and Roth (1994) and Zhao et al. (2006). We partially adapted the items used to measure business costs, competitive intensity, and labor shortages from Ward et al. (1996). We developed items measuring the performance, such as sales growth and profitability, specifically for this study. Following Zhao et al. (2004), the performance outcomes are measured on nine-point Likert scales, which can provide more variance (Zhao et al., 2004). The questionnaire items appear in Appendix.

The adequacy of these multi-item scales in capturing their constructs is also assessed using a confirmatory model. The confirmatory model is tested on the full dataset by using the EQS 6.1 program (Bentler, 1995). The goodness-of-fit indices suggest an excellent fit for this model: the Chi-square value with 80 degree of freedom is 194 (P=0.00; ratio of chi-square to the degrees of freedom= 2.4), NFI=0.91, NNFI=0.92, CFI=0.94, IFI=0.94, SRMR=0.04, and RMSEA =0.06. As shown in the Appendix, all the items have a large, significant loading on their designated constructs. To evaluate the convergent validity, we compute average variance extracted (AVE) for each of the constructs. As presented in the Appendix, all the AVEs exceed the recommended minimum level of 0.5, indicating the convergent validity of the constructs (Fornell and Larcker, 1981). To test discriminant validity of the constructs, we compare the amount of shared variance of any two constructs with the AVEs of the constructs. The result of this test shows that the AVE of each construct is larger than the shared variances between all pairs of factors in the model, indicating a satisfactory level of discriminant validity (Fornell and Larcker, 1981). Additionally, we calculated composite reliability to check the consistency and reliability for the multi-item scales. All the composite reliability values exceed 0.6 (see Appendix), adequate for an exploratory study such as the current one (Nunnally, 1978).

Our scales exhibit nomological and theoretical validity, because they reflect an extensive review of manufacturing strategy literature (e.g., Miller and Roth, 1994; Safizadeh et al., 2000; Ward et al., 1995; Zhao et al., 2006). Evidence of criterion-related validity, or the extent to which a construct is related to other theoretically connected constructs (Schwab, 1980), emerges from our analysis that links manufacturing strategy to performance. The stratified probability proportional to sizes method ensures cross-sample consistency, such that the findings are representative of the population (Badri et al., 2000; Ward et al., 1995).

Table 3 presents the means, standard deviations, and correlations of the constructs measured by Likert-type scales.

Results

Data Analysis and Results

Following Fiss (2011), we employ a new analytical technique, Fuzzy set Qualitative Comparative Analysis (FsQCA) to identify the manufacturing strategies leading to high organizational performance. FsQCA was originally designed for qualitative research with small to medium sample sizes, but was recently adapted by a number of researchers to analyze a large dataset for theory development and validation (Cooper and Glaesser, 2011; Fiss, 2007; Woodside, 2013). It examines the effects of various configurations of antecedents, rather than the individual antecedents, on the outcomes (Schneider et al., 2010). By doing so, it is able to identify alternative configurations of sufficient conditions and thus enables the testing of equifinality (Fiss, 2007; Ragin, 2008). For each configuration, it also identifies necessary, core, and peripheral conditions among the included antecedents (Fiss, 2011; Ragin, 2008).

Table 3: Means, Standard Deviations, and Correlations

	Mean	Std Dev	QA	DL	CE	VF	DF	BP	UC	MU	PR	SG
Quality (QA)	4.40	0.59	1	.549**	.338**	.337**	.386**	.380**	.361**	.361**	.234**	.309**
Delivery (DL)	4.17	0.73	.549**	1	.460**	.407**	.449**	.375**	.348**	.348**	.259**	.358**
Cost efficiency (CE)	4.21	0.70	.338**	.460**	1	.439**	.428**	.358**	.259**	.259**	.130**	.164**
Volume flexibility (VF)	4.22	0.78	.337**	.407**	.439**	1	.624**	.487**	.238**	.238**	.181**	.228**
Design flexibility (DF)	3.95	0.74	.386**	.449**	.428**	.624**	1	.652**	.285**	.285**	.290**	.329**
Broad product line (BP)	3.62	1.01	.380**	.375**	.358**	.487**	.652**	1	.341**	.341**	.267**	.310**
Uncertainty (UC)	4.14	0.54	.361**	.348**	.259**	.238**	.285**	.341**	1	1.000**	.220**	.293**
Munificence(MU)	4.14	0.54	.361**	.348**	.259**	.238**	.285**	.341**	1.000**	1	.220**	.293**
Profitability (PR)	7.08	2.05	.234**	.259**	.130**	.181**	.290**	.267**	.220**	.220**	1	.728**
Sales growth (SG)	7.67	1.72	.309**	.358**	.164**	.228**	.329**	.310**	.293**	.293**	.728**	1

* $p < .05$. ** $p < .01$. *** $p < .001$.

Calibration of the Data

FsQCA calibrates variables as fuzzy set scores ranging from 0 to 1, reflecting their degrees of membership within predefined sets. A crossover anchor (often around 0.5) needs to be established for a qualitative distinction between the "in" and "out" parameters of a set. In this study, performance indicators are measured by 9-point Likert-type scales, while other dimensions are measured by 5-point Likert-type scales. For constructs using multi-item scales, mean scores of the scale items are first calculated as the construct score. Following Fiss (2007), we code the membership as "full in" for the construct score of 9 for performance, and 5 for other dimensions. We code the membership as "full out" for the construct score of 1. The midpoint scores (3 for 5-point Likert-type scales and 5 for 9-point Likert-type scales) theoretically correspond to the crossover anchor "neither in nor out". However, setting them as the anchors will result in the cases with midpoint scores (fuzzy set score of 0.5) being dropped from the FsQCA analysis. Thus, we set the crossover anchor at the score of 3.1 for 5-point Likert-type scales and 5.1 for 9-point Likert-type scales. This assures that no case will be dropped and it does not affect the analysis results (Fiss, 2007). Based on the aforementioned criteria, we transform the raw scores into membership scores, ranging from 0 to 1, using the direct method of calibration provided by FsQCA software (Ragin, 2008).

Fsqca Analysis Procedure

As suggested by Ragin (2008), we run two two-step FsQCA analyses to test our hypotheses, with sales growth and profitability as the outcomes, respectively. The competitive priorities are entered as antecedents in the analyses. To test the viability of the manufacturing strategies across different business environments, we also include two major dimensions of environment as antecedents, such as munificence and uncertainty. Uncertainty refers to unpredictable changes in the environment, while munificence refers to extent of slack or scarcity of resources in an environment (Dess and Beard, 1984; Lawless and Finch, 1989; Ward et al., 1995). Specifically, for the dimension of munificence, we include three elements widely studied in prior studies on manufacturing strategies (Amoako-Gyampah, 2003; Amoako-Gyampah and Boye, 2001; Badri et al., 2000; Ward et al., 1995), such as business costs, labor shortage, and competitive intensity. For the dimension of uncertainty, we include elements such as uncertainty in the product market, that in the supply market, and that in terms of overall operations costs. Arguably, if a strategy is only viable in a particular environment, the environmental forces will become core conditions for the firms in the strategic group to succeed. In other words, this strategy and this particular environment, together, constitute a set of core conditions leading to firms' success.

At the first step of analysis, we conduct a necessary condition test for the two outcomes. FsQCA evaluates "necessity" of a condition based on the extent to which the instances of the outcome constitute a subset of the instances of the antecedent (Ragin, 2000; 2008). Specifically, consistency scores are calculated by using FsQCA software (Ragin, 2000). A consistency score of 0.9 or above indicates that an antecedent is a necessary condition. Nevertheless, a necessary condition could be a trivial one if it occurs in all cases, independent of the presence of an outcome. To measure the degree to which an antecedent is trivial, we calculate coverage score. A coverage score close to 0 indicates that an antecedent is trivial (Schneider et al., 2010), and is not essential to the outcomes.

At step two, we exclude the individual antecedents deemed necessary at step one from further analysis. The remaining antecedents are analyzed to determine whether they form alternative configurations leading to the outcomes (Ragin, 2008). For each outcome, FsQCA software constructs a truth table with 2^k rows, representing all the possible combinations of causal conditions (k is the number of antecedents) (Ragin, 2008). Each sample case is then assigned to one of the combinations, based on its membership scores on each of the antecedents. A key task at this step is to establish a number-of-case threshold based on nature of the study (Ragin, 2008). If there are more cases belonging to the combination than the threshold number, the combination is regarded as a *relevant configuration* in the analysis. The remaining combinations are regarded as *remainders*. For the current study, we set this threshold at 5.

Next, we calculate the consistency score for the relevant configurations (Ragin, 2008). The consistency score threshold is set at 0.9, consistent with prior studies (e.g., Cheng et al., 2013; Schneider et al., 2010). Furthermore, as suggested by Rubinson (2013), we also set a consistency proportion threshold of 0.9. This threshold specifies the minimum ratio of “consistent cases to all cases” required to classify a configuration as one that meets the requirement of sufficiency. In sum, a configuration is coded 1, indicating its sufficiency (i.e., it “almost always” leads to the outcome), if (a) the number of cases belonging to this configuration is more than 5; (b) overall consistency score is at least 0.9; and (3) at least 90% of the cases in the configuration are consistent with sufficiency (consistency proportion >= 0.9).

Finally, we run FsQCA software to yield solutions (Ragin, 2008). The program produces three solutions for each analysis: a complex solution, a parsimonious solution, and an intermediary solution by using counterfactual analysis. Essentially, the conditions appearing in parsimonious solutions could be regarded as core conditions, while those appearing in intermediate solutions, but not in parsimonious solutions, could be regarded as peripheral ones (Fiss, 2011).

In this paper, we report both intermediate and parsimonious solutions. We also report two types of coverage at this step: (1) raw/solution coverages, which measure the extent to which configurations identified by the analysis account for the outcome; and (2) unique coverage, which refers to the proportion of memberships in the outcome, and is solely determined by a particular configuration (Ragin, 2008).

Analysis Results

As shown in Table 4, emphasis on quality is found to be a necessary condition for both sales growth and profitability, supporting H1 a and b. Additionally, emphasis on delivery is found to be a necessary condition for profitability. The final FsQCA analysis results are presented in Table 5, which presents necessary, core, and peripheral conditions for the configurations of competitive priorities leading to high sales growth and profitability. All the raw and solution coverage values are above 0.1(10%), indicating that the configurations explain a large portion of their designated outcomes. Five solutions emerge as configurations leading to sales growth. Among them, configuration 1 is generally consistent with the profile of prospector manufacturing strategy. Its core conditions include emphasis on volume and design flexibility, as well as absence of emphasis on cost efficiency. Thus, H2a-c are supported. Delivery turns out to be the peripheral condition, supporting H2d. Absence of emphasis on broad product line turns out to be a core condition, rejecting H2e.

Table 4: Necessarity Test

Antecedent	**Outcomes**	
	Sales growth	**Profitability**
Quality	0.94*[1](0.91[2])	0.94*(0.84)
Delivery	0.89 (0.92)	0.90* (0.86)
Cost efficiency	0.88 (0.91)	0.89 (0.84)
Volume flexibility	0.88(0.91)	0.89(0.84)
Design flexibility	0.85(0.93)	0.86 (0.88)
Broad product line	0.74(0.94)	0.76(0.89)

Note: *: pass the consistency threshold; 1 = Consistency; 2 = Coverage

Table 5: Fsqca Analysis Results-Necessary, Core, and Peripheral Conditions

	Outcome: sales growth					Outcome: profitability	
Configurations	**1**	**2**	**3a**	**3b**	**4**	**5**	**6**
Quality	N	N	N	N	N	N	N
Delivery	P	P	~C	~C	C	N	N
Cost efficiency	~C	C	C	C	C	~C	C
Volume flexibility	C	~C	~P	P	P	P	~C
Design flexibility	C	C	~P	P	P	P	C
Broad product line	~C	~P	~C	~C	C	C	
Uncertainty	~P	~P	~P	~P		~P	~P
Munificence	P	P	P	P	P	P	P
Consistency	0.98	0.98	0.97	0.97	0.96	0.95	0.95
Raw coverage	0.18	0.18	0.14	0.18	0.66	0.21	0.21
Unique coverage	0.01	0.01	0.01	0.01	0.44	0.05	0.05
Overall solution consistency			0.96			0.94	
Overall solution coverage			0.69			0.27	

Note: N- necessary condition; C-core condition; P-peripheral condition; ~absence of the condition.

Configuration 2 resembles the profile of defender manufacturing strategy. Cost efficiency is a core condition in this configuration, consistent with H4a. Delivery is a peripheral condition, partially supporting H4b. Absence of emphasis on broad product line turns out to be a peripheral condition, partially supporting H4c. Absence of emphasis on volume flexibility is a core condition, consistent with H4d. Emphasis on design flexibility is a core condition, partially supporting H4e. Configuration 3a is also similar to defender, with core conditions such as emphasis on cost efficiency, as well as absence of emphasis on broad product line. This is consistent with H4 a and c. Additionally, absence of emphasis on volume flexibility is a peripheral condition in this configuration, offering partial support to H4d. However, absence of emphasis on delivery becomes a core condition for this strategy, contradicting H4b. Absence of design flexibility turns out to be a peripheral condition, contradicting H4e.

Configuration 3b shares the same core conditions with configuration 3a. Thus, it is also consistent with H4a and c, and contradicts H4b. However, volume and design flexibility turn out to be peripheral conditions in this configuration, while absence of these two priorities are peripheral conditions in 3a. This contradicts H4d (absence of volume flexibility is a core condition), but is consistent with H4e (design flexibility is a peripheral condition). In sum, the configurations 2, 3a, and 3b all resemble defender manufacturing strategies to some extent, but do not perfectly meet the profile of this ideal type. They could be regarded as different variations of this strategy. Finally, configuration 4 is consistent with the profile of analyzer manufacturing strategy, with core conditions such as emphasis on cost efficiency, delivery, and broad product line, as well as peripheral conditions of emphasis on volume and design flexibility. Thus, H6 a-e are supported.

As for the outcome of profitability, FsQCA analysis produces two configurations. Configuration 5 is consistent with the profile of prospector manufacturing strategy. Absence of cost efficiency is a core condition, consistent with H3c. Emphasis on volume and design flexibility are peripheral conditions, partially supporting H3a and b. As mentioned, emphasis on delivery is a necessary condition, partially supporting H3d. Emphasis on broad product line is a core condition, partially supporting H3e. Configuration 6 is consistent with the profile of defender. Emphasis on cost efficiency is a core condition, supporting H5a. Emphasis on delivery is a necessary condition, partially supporting H5b. Emphasis on broad product line does not affect profitability, contradicting H5c. Absence of emphasis on volume flexibility is a core condition, supporting H5d. Emphasis on design flexibility is a core condition, partially supporting H5e. The analysis does not yield a configuration resembling analyzer, rejecting H7a-e.

Finally, munificence and stability (lack of uncertainty) turn out to be peripheral conditions, but not core conditions, in the configurations produced by the two FsQCA analyses, except for configuration 4, in which uncertainty does not affect sales growth at all. Thus, none of the strategic types identified is environment-specific.

Discussion

In this study, we utilize FsQCA to identify configurations of competitive priorities leading to two organizational outcomes, namely, sales growth and profitability. FsQCA analysis yields five configurations for sales growth and two for profitability. We first discuss the two sets of configurations, and then their implication for managers

Manufacturing Strategies Leading to Sales Growth

For sales growth, while configurations 1 and 4 fit the profiles of prospectors and analyzer respectively, configurations 2, 3a, and 3b represent three different alternatives of defender manufacturing strategy. These findings, however, are consistent with Walker and Ruekert (1987)'s classification of low cost and differentiated defenders. Based on both Miles and Snow's typology and Porter (1985)'s typology of cost leadership and differentiation, Walker and Ruekert (1987) argue that there exist two types of defender strategies. Both of them attempt to maintain their position in mature markets. However, to achieve this goal, one group strongly emphasizes low costs (low cost defender), while the other focuses on offering unique product and excellent service (differentiated defender).

Our configuration 3a fits the profile of low cost defender. It is the most conservative strategy. Emphasis on cost efficiency, as well as lack of emphasis on delivery and broad product lines, constitute core condition. Lack of emphasis on volume and design flexibility constitute peripheral conditions. Configuration 3b shares the same core conditions as configuration 3a. However, emphasis on the two types of flexibility turns out to be peripheral conditions in configuration 3b, indicating that firms in this strategic group could develop either volume or design flexibility, or both of them, to enhance performance (if neither type of flexibility is emphasized, it would retrogress to configuration 3a) Thus, configuration 3b reflects a manufacturing strategy supporting a differentiated defender strategy at the organizational level.

On the other hand, configuration 2 reflects another type of differentiated defender strategy. As core conditions, firms in this group emphasize cost efficiency but not volume flexibility, which is consistent with the profile of classic mass manufacturers. Yet, emphasis on design flexibility is another core condition, indicating that this strategic group tends to maintain their competitiveness by quickly catering to changing customer needs. Furthermore, delivery is a peripheral condition in this configuration, indicating that offering excellent delivery service could further enhance their competitiveness. Firms in this strategic group may engage in *mass customization*, which utilizes modern engineering techniques to customize products for customers without sacrificing economies of scale (Duray et al., 2000; Pine et al., 1995).

Manufacturing Strategies Leading to Sales Growth

Unlike in the strategies leading to sales growth, delivery turns out to be a necessary condition in the strategies leading to profitability. A possible explanation is that, a firm's sales growth often comes from new customers, who experience the firm's delivery *after* their orders are placed. As such, while a firm's reputation on delivery might attract new customers, this priority is not as important in facilitating sales growth as in retaining existing customers. The existing customers have experienced the firm's delivery in their previous orders, and may become reluctant to place orders again if the experience was unsatisfactory. Since existing customers may contribute to a major portion of a firm's profit, delivery becomes essential (a necessary condition) to the firm's profitability.

Our analysis shows that only two manufacturing strategic groups, defender and prospector, lead to high profitability. Analyzer manufacturing strategy, however, does not emerge in the FsQCA analysis. As mentioned, analyzers operate in both stable and dynamic market segments. They share the characteristics of defender in the stable markets, and those of prospectors in the dynamic markets (Conant et al., 1990; Desarbo et al., 2005). Their operation functions thus need to develop and maintain capabilities geared specifically to the two distinct types of markets. However, maintaining two types of operation capabilities could be relatively costly and reduce firms' profitability. This result is consistent with Fiss (2011)'s finding that analyzer organizational strategy cannot achieve extremely high performance in terms of returns on investment (ROI).

The prospector strategy leading to high profitability (configuration 5) has a core condition of emphasis on broad product lines. In contrast, the prospector manufacturing strategy leading to high sales growth (configuration 1) consists of a core condition of *absence* of emphasis on the same priority. We may label the former strategy as "broad prospector", since it operates in broad markets, while the latter one as "niche prospector", since it focuses on a narrow market segment. The "broad prospectors" engaging in several market segments are often established firms, which may place more emphasis on profitability than sales growth. Furthermore, with their operations in several market segments, broad prospectors are more likely to obtain steady profit than niche prospectors, which operate in a single market. As such, broad prospector strategy is more likely to result in profitability.

On the other hand, the defender strategy leading to profitability (configuration 6) is similar to one of the *differentiated defender* strategies for sales growth, i.e., configuration 2. Compared to other two defender strategies (configurations 3a and 3b), its simultaneous emphasis on delivery and design flexibility is more likely to satisfy existing customers, thereby enhancing profitability.

Implication for Managers

Our findings indicate that competitive priorities constitute different types of conditions for outcomes in each strategic group. To achieve desirable outcomes, firms' decision on manufacturing strategies should be made based on the relative importance of the priorities. No matter which business strategy they wish to adopt, firms need to first place emphasis on the competitive priorities constituting necessary conditions. Next, firms should pay attention to the core conditions, and then design their strategies correspondingly. For example, it is difficult to implement a defender strategy without cost efficiency. If a firm lacks capabilities related to cost efficiency, two options are available: (1) it may adopt an alternative business strategy, which does not emphasize cost efficiency; or (2) it may place emphasis on this priority and make efforts to improve it. It can adopt modern manufacturing technologies to improve cost efficiency. Finally, satisfying all the necessary, core, and peripheral conditions inherent in a specific manufacturing strategy is desirable. However, in practice, some firms may lack sufficient resources for their operations functions. In this case, they may trade off the peripheral conditions for the necessary and core conditions. By doing so, they can maintain the key elements of their selected manufacturing strategy in order to support their corresponding business strategy.

Our study also shows that business goals such as sales growth and profitability place somewhat different requirements on operations functions, and demand different configurations of competitive priorities. Therefore, when developing manufacturing strategies, firms first need to consider whether to trade off various business goals. A firm may select one particular business goal deemed most important, and, subsequently, design a manufacturing strategy to best support that goal. For example, an emerging high-tech firm may decide to adopt a prospector strategy and focus solely on sales growth. Its manufacturing strategy thus should be optimized for this purpose. Alternatively, a firm may decide to pursue several goals simultaneously. Tradeoffs thus should be made at the manufacturing strategy level, if these goals demand different operational capabilities. For example, if an analyzer wishes to pursue both sales growth and profitability, it may devote more resources to the operations functions serving its stable market domain, and less to those serving the dynamic domain. This enhances its capability of acting like a defender to obtain profitability in a stable market, at the cost of its ability of acting like a prospector to seek a new market domain for sales growth. Nevertheless, a possible consequence of such a compromise is that the firm is likely to perform well, but not best, in pursuing each of the goals.

Limitation and Future Research

Our study has some limitations which in turn provide directions for future research. First, we have examined firms' emphases on competitive priorities, not their actual capabilities. Additional research should investigate both firms' manufacturing strategies and their actual capabilities, thereby testing whether firms can actually achieve satisfactory performance, if they faithfully implement their manufacturing strategies.

Second, we collected all our data from China. Future researchers may further test the typology in different countries to establish its stability. We anticipate that similar strategic groups, consistent with the Miles and Snow typology, will be found. Yet, some competitive priorities emphasized by these strategic groups, especially those constituting peripheral conditions, may differ from our results, due to the unique characteristics of these countries.

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Appendix I. Questionnaire Items

Please indicate the degree to which the following are your company's major priorities, using a scale of 1 to 5, with 1 being "very unimportant" and 5 being "very important."

Quality (AVE=0.56, CR=0.84)[1]
Performance quality
Product durability
Conformance quality
Reduction of defective
(summed up and divided by 4)

Delivery (AVE=0.72, CR=0.84)
Delivery speed
Delivery dependability
(summed up and divided by 2)

Cost (AVE=0.53, CR=0.69)
Reduce production costs
Reduce inventory costs
(summed up and divided by 2)

Design flexibility (AVE=0.63, CR=0.77)
Ability to introduce new product
Ability to make rapid design change
(summed up and divided by 2)
Volume flexibility
Broad product line

Uncertainty (AVE=0.59, CR=0.88)

Please indicate the degree of uncertainty related to the following aspects in your business environment, using a scale of 1 to 5, with 1 being "very unpredictable" and 5 being "always predictable". (reverse coded)

Demand for your products
Customers' needs
Competitors' actions
Supply of raw materials/parts
Operations costs
(summed up and divided by 5)

Munificence[1]

Please indicate the degree to which the following are major concerns to your company, using a scale of 1 to 5, with 1 being "very unimportant" and 5 being "very important."

Rising business costs
Lack of desirable labor
Competition in domestic markets
Competition in foreign markets
(summed up and divided by 4)

Please select the response that best indicates how true each of the following statements is about your company's performance, compared with your major competitors, using a scale of 1 to 9, with 1 being "strongly disagree" and 9 being "strongly agree".

Sales growth
Your company's sales growth is excellent

Profitability
Your company's profitability is excellent

Note: 1. AVE= Average Variance Extracted, CR=Composite Reliability

1. The construct of munificence, which is measured using multi-item, formative scales, is excluded from the confirmatory factor analysis. Thus, no AVE and CR are calculated. The formative scales are taken as causes of the construct in question (Pedhazur and Schmelkin. 1991). These indicators need not be highly correlated (Pedhazur and Schmelkin., 1991). For example, a firm facing intensive competition overseas does not necessarily face intensive domestic competition, and vice versa. As such, we do not expect internal consistency for the formative scales (Bollen and Lennox, 1991) and, hence, exclude them from the confirmatory factor analysis.