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Cluster analysis application for understanding SME manufacturing strategies

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ABSTRACT

Small and medium size enterprises' (SME) manufacturing strategy configurations are identified in a small developed economy with the aim to explore how SME manufacturing strategy configurations affect business stability and performance during a period of macroeconomic shock. Drawing on a survey-based dataset, our two-step cluster analysis results suggest that three distinctive manufacturing strategy configurations can be observed among the SMEs of the Finnish manufacturing sector, namely: Responsive niche-innovators, Subcontractors, and Engineer-servers. Furthermore, we are able to establish a link between the strategy configurations and business stability and performance. The results support conclusions that the nature of manufacturing strategy taxonomies are driven by the business context, and that volume flexibility, design flexibility and service provision capabilities enable better business outcomes during macroeconomic shocks, in comparison to the more easily achievable conformance quality as well as delivery speed and dependability. In light of this research, best performing cluster under the macroeconomic shock is the Engineer-servers, emphasizing flexibility-oriented broad product line and after sales service, while having less priority concerning low price and volume flexibility. The results offer important insights for managers, but also for other stakeholders in the form of for example expert systems development for SME funding decisions.

1. Introduction

A severe recessionary period affected many developed economies in the late 2000s, hastening industrial restructuring. These adverse conditions threatened the survival of many small and medium sized firms (SME) in the manufacturing sector (defined as firms with a turnover of less than 50 MEUR and personnel headcount less than 250 according to the European Commission), as they often suffer, for example from, vulnerability (Smallbone, Deakins, Battisti, & Kitching, 2012), e.g. due to the 'liability of smallness' (Aldrich & Auster, 1986; Flatten, Greve, & Brettel, 2011). Such characterization suggests little or no diversification and considerable resource constraints (Pearce & Michael, 1997). At the same time, manufacturing firms, one may argue, remain the backbone of developed economies (Pitelis & Antonakis, 2003), and thus their prospects for survival are also of interest to policy makers, but also to creditors and society at large. Recent research in the SME field on expert and intelligent systems has concentrated on credit ratings (Derelioglu & Gürgen, 2011; Li, Niskanen, Kolehmainen, & Niskanen, 2016), bankruptcy prediction models (Gordini, 2014) and fund investment policies (Sohn, Kim, & Moon, 2007). Such efforts would benefit from understanding the nature of SME manufacturing strategies and their implications to business stability and performance in uncertain environments.

Importantly, evidence suggests that appropriate manufacturing strategies and capabilities related to them have a key role in supporting competitive strategies for high business performance (e.g. Ward & Duray, 2000). Whereas the recession resistance of marketing and business strategies has been investigated in several studies (see Bamiatzi & Kirchmaier, 2014; Ho, Choy, Chung, & Lam, 2010; Köksal & Özgül, 2007; Pearce & Michael, 1997 and 2006), which generally suggests that a recession should not be just weathered with "cutbacks and retrenchment" (e.g. Pearce & Michael, 1997, 302), there appears to be a research gap in terms of understanding the nature of manufacturing strategies that may be advantageous under the specific conditions encountered during macroeconomic shocks. Therefore, in order to investigate whether empirically observed manufacturing strategies differentiate in terms of firm performance in such adverse conditions, we pose the following re-

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search question: *What are the implications of different SME manufacturing strategies on business outcomes during macroeconomic shocks?*

In accordance with the research question, we empirically identify a taxonomy of typical manufacturing strategies among SME manufacturers in Finland, which is a small developed economy, and explore the implications that the macroeconomic shock of the late 2000s—and its aftermath in the early 2010s—had for the firms employing the identified manufacturing strategies. Finland is chosen as the context of research due to the severity of the macroeconomic shock and the subsequent industrial restructuring.

In essence, we subject the identified strategies to a critical test, allowing us to observe their stability and performance during a macroeconomic contraction shock, and their ability to recover during a macroeconomic expansion shock (Amann & Jaussaud, 2012; Kesavan & Kushwaha, 2014). Similarly to Kesavan and Kushwaha (2014), we define a macroeconomic shock as an unexpected change in macroeconomic conditions, i.e. a financial-economic crisis that has a negative effect on the demand for the products of manufacturing firms. Such sudden changes in demand have an effect on business outcomes, such as profitability and employment.

Theoretically, we base our research on the resource-based view (RBV) of the firm (Barney, 1996; Wernerfelt, 1984), and concur with the literature which suggests that the value and optimality of a firm's resources and capabilities depend as much on the context as on the properties of the asset (Miller & Shamsie, 1996; Priem & Butler, 2001; Wan, 2005), such as various manufacturing strategies. Through our research, we are able to contribute to the theoretical discussion on the appropriateness of the manufacturing strategies, and the underlying capabilities, used during macroeconomic shocks, such as recessions. Additionally, we contribute to the methodological discussion about the appropriateness of the measurements and data analysis for determining manufacturing strategy taxonomies.

In the following section, we consider the linkage between manufacturing strategy and performance, particularly in the context of macroeconomic shocks. We also develop a framework for the research. In section three, the macroeconomic shock that faced Finnish manufacturing SMEs is described. The research methodology is described in section four, while section five elaborates on the results of the data analysis and our cluster solution is linked to business stability and performance. The research results are discussed in section six, and section seven concludes our research but also proposes further research.

2. Theoretical foundation

2.1. Performance implications of a manufacturing strategy

The practical design and implementation of a manufacturing strategy that supports overall business aims is a complex task, involving dozens of variables. Configuration models, defined as "multidimensional profiles used to describe organizational, strategy, or process types" have been suggested as a useful approach for addressing the requirements of contextual and internal fit with a manufacturing strategy (Bozarth & McDermott, 1998). Configuration models are typically divided into taxonomies and typologies, each representing unique combinations of manufacturing strategy dimensions. However, research often addresses only single dimensions of manufacturing strategy as predictors of firm performance, while also considering the possible mechanisms required for such effects to take place (e.g. Anand & Ward, 2004). Usefully, this literature describes the decisions that are made about forming capability bundles which combine several dimensions of manufacturing strategy, such as low price, design flexibility, a broad product line, volume flexibility, conformance quality, performance quality, delivery speed, delivery dependability, after sales service, and broad distribution and advertising (e.g. Miller & Roth, 1994). In the following, we discuss the possible connections these individual dimensions have to firm performance and, in particular, to firm performance during recession and macroeconomic shocks.

In terms of the single dimensions of manufacturing strategy, quality has been suggested as a foundational capability that significantly contributes to firm performance (Ferdows & DeMeyer, 1990; Noble, 1995). Environmental dynamism, i.e. the speed of obsolescence, rate of innovation of products and processes, rate of change in customers' preferences, is said to be associated with differentiated manufacturing strategies, to contain quality as its leading component, and also to serve as a driver of business performance (Ward & Duray, 2000). Roberts (2003) suggests the importance of investing in "customer-perceived quality" during a recession due to the benefits accrued in terms of profitability and post-recession growth.

Empirical evidence suggests that flexibility has a beneficial impact on performance and adds to the competitive advantage of manufacturing firms (Swamidass & Newell, 1987). This proposition was later strengthened by Anand and Ward (2004), who suggested flexibility is a stronger predictor of performance in a dynamic environment, one that is a combination of unpredictability and volatility. The results showed that a strategy based on flexibility needs to fit with the environment in order for firms to reap performance benefits, specifically: an unpredictable environment requires mobility flexibility, i.e. design and volume, whereas volatile environment requires range flexibility, i.e. a broad assortment and variety. In a similar vein, Kovach, Hora, Manikas, and Patel (2015) suggest that in an unpredictable environment, companies that are essentially diversified and have broad product lines and a wide geographic sales scope perform better, and that in unstable environments, excess capacity allows better performance due to the ability to capture opportunities. Firms that demonstrate flexibility related capabilities may therefore perform better during unexpected macroeconomic shocks, including both the contraction and expansion periods (Kesavan & Kushwaha, 2014). In essence, they are able to both hedge against and respond to significant swings in demand (Kovach et al., 2015; Upton, 1994), which is essentially a form of environmental dynamism, as shocks demonstrate both unpredictability and volatility.

Whereas the literature on marketing strategy points out the benefit of increasing "the breadth of production" and its geographic coverage before a recession (Pearce & Michael, 1997; 2006), Köksal and Özgül (2007) do not find evidence that supports market diversification in the context of an economic crisis. A low cost strategy, as well as increasing the number of channels, or an emphasis on broad distribution (as originally included in the manufacturing strategy dimensions by Miller & Roth, 1994), do not seem to fit well with a recessionary context (Pearce & Michael, 1997).

The value of linking new product development and manufacturing strategy, e.g. in the form of a product or service customization capability and design flexibility, has been recognized in the literature (e.g. Spring & Dalrymple, 2000), and also in adverse economic conditions (Bamiatzi and Kirchmaier, 2014). From the RBV perspective, Schroeder, Bates, and Junttila (2002) show that superior performance in manufacturing results from firms' proprietary processes and equipment, which are driven by external and internal learning. This highlights the potentially significant role of new product, service and process development capabilities like design flexibility—which are difficult to imitate and copy—in explaining a manufacturing firm's performance. The literature presents evidence that connects innovation emphasis with firm performance (e.g. Calantone, Cavusgil, & Zhao, 2002), and also connects firm performance with the condition of the dynamic external environment (Garg, Walters, & Priem, 2003). Relevantly, Köksal and Özgül (2007) show that an increased R&D budget during economic downturns has beneficial performance implications for firms (see also Roberts, 2003; Bamiatzi and Kirchmaier, 2014)

Furthermore, servitisation, e.g. adding after-sales, customer support, outsourcing service provision and development services to the core product (Gebauer, 2008), has been suggested as a strategy for counteracting the effects of the rapid commoditization of industrial products (Matthyssens & Vandenbempt, 2008). Kastalli and Van Looy (2013) establish a positive but non-linear relationship between the scale of a manufacturers' service activities and its profitability. Relevantly for our study, the service industry has been proposed as being countercyclical, i.e. after-sales services may take on a more significant role in generating sales during a recession as demand for a firm's core products declines (Gebauer & Fleisch, 2007; Kindström & Kowalkowski, 2014).

Considering the interrelatedness of the various dimensions of manufacturing strategy, Christiansen, Berry, Bruun, and Ward (2003) place an emphasis on the role of bundles of manufacturing practices as predictors of performance, and show that manufacturers with a low price emphasis need to excel in other practices, i.e. low price is not an adequate order winning factor on its own, whereas differentiators can excel selectively (see also Noble, 1995, for further evidence on the importance of multiple capabilities for improved performance). A stream of research also suggests a cumulative model for manufacturing competitive priorities (e.g. Kathuria, 2000), according to which high performing firms "build one manufacturing capability upon another in a sequential, cumulative fashion—starting first with quality, followed by dependability, delivery, cost efficiency, flexibility, and lastly, innovation" (Noble, 1995, 693). While this could implicitly suggest a pattern of manufacturing strategy maturity, later research argues that "there is no strategic configuration that appears to be the final 'maturity' target for manufacturers" (Cagliano, Acur, & Boer, 2005, 715). Nevertheless, the cumulative model suggests that certain capabilities are more difficult to build up and maintain, and therefore these are more likely to provide a sustainable competitive advantage due to their valuable, rare, imperfectly imitable, non-substitutable attributes (Barney, 1991; Schroeder et al., 2002), particularly in adverse economic conditions.

Concluding this section by drawing on the previously discussed literature on the linkages of individual manufacturing strategy dimensions and macroeconomic shocks, as well as on the cumulative model, we suggest the following proposition:

P1: Firms which demonstrate better business performance or stability during macroeconomic shocks are more likely to emphasise design flexibility, volume flexibility and servitization as part of their manufacturing strategy configuration.

2.2. Research framework

This section builds a framework for the research and elaborates on its central components, namely (1) manufacturing strategy and (2) business outcomes. As the theory on the association of these components was discussed in the previous section, the emphasis is hereby given to definitions and operationalizations. Acknowledging the seminal contributions on manufacturing strategy (Hayes & Pisano, 1996; Skinner, 1969; Swamidass & Newell, 1987; Ward & Duray, 2000), we purposefully focus on the literature on manufacturing strategy taxonomies. An influential taxonomy has been proposed by Miller and Roth (1994), which is based on eleven capability taxons and is broader than the cost-quality-delivery-flexibility framework created by Skinner (1969) (see also Kathuria, 2000), which includes low price, design flexibility, a broad product line, volume flexibility, conformance quality, performance quality, delivery speed, delivery dependability, after sales service, broad distribution and advertising. The empirical work focused on large North American firms and resulted in three distinct manufacturing strategy configurations, or clusters, namely Caretakers, Innovators and Marketeers (Miller & Roth, 1994).

In subsequent research, oriented on testing the suggested taxonomy, Frohlich and Dixon (2001) used longitudinally replicated global data and similar data collection instruments; however, some of the taxons were dropped in latter data collection rounds, i.e. the marketing oriented dimensions of broad distribution and advertising. Frohlich and Dixon (2001) found partial support for the three strategy-types developed by Miller and Roth (1994); however, Marketeers was later replaced by Designers, and three other unique strategies were identified as well: Idlers, Servers, and Mass Customizers. Zhao, Sum, Qi, Zhang, and Lee (2006) tested the Miller and Roth (1994) taxonomy (without the two previously identified marketing oriented taxons) in the Chinese context, choosing to sample from a typical city, Tianjin. The results gained by Zhao et al. (2006), with a sample including a significant portion of SMEs, suggest a taxonomy that is different from the strategic clusters of Miller and Roth (1994) due to such strategy configurations as Quality Customizers, Low Emphasizers, Mass Servers, and Specialized Contractors.

Considering the extant research, it appears that the generic manufacturing strategy configurations of incumbent firms reflect the comparative advantage or competitive pressures in the host countries, such as is the case of Designers found in Western Europe (Frohlich & Dixon, 2001) or Mass Servers and Specialized Contractors found in China (Zhao et al., 2006). Furthermore, Dangayach and Deshmukh (2001) suggest that priorities in terms of manufacturing strategy may vary from industry to industry. In conclusion, the nature of the taxonomies found through empirical research in various settings, may reflect country and industry characteristics that are unique to the particular environment.

The central tenet of this research is that strategy determines performance (Fig. 1), an assumption which is salient in strategic management research (e.g. Cavusgil & Zou, 1994; Snow & Hrebiniak, 1980). According to P1, an emphasis on certain dimensions of strategy contributes to a more stable business and higher levels of performance. Manufacturing strategy is here defined as a combination of theoretical manufacturing strategy dimensions, with each given a varying level of emphasis, thus constituting a configuration (Bozarth & McDermott, 1998). Recognizing the evolution in the used dimensions or taxons for measuring and determining manufacturing strategy configurations, we adopt the latest version suggested by Zhao et al. (2006), as depicted in Fig. 1.

Another assumption made in our study is the relative rigidity of the manufacturing strategy configurations of firms (measured in our research in early 2014) during the observation period of 2008–2013. This assumption may be considered acceptable because, by definition, strategy and related planning is long-term oriented (Chandler, 1962, 13; De Baerdemaeker & Bruggeman, 2015). Furthermore, based on their empirical study of SMEs, Leitner and Güldenberg (2010, 184) find a "considerable level of persistence in the strategies followed, with the majority of firms sticking to their chosen strategy over the entire period". They also suggest that "this type of behaviour is especially typical in owner-managed SMEs". It has been suggested that the liability of smallness (Aldrich & Auster, 1986; Flatten et al., 2011) limits the resources available for innovation in terms of business models and manufacturing strategies, and that this is especially so during recessionary periods (Kindström & Kowalkowski, 2014). The assumption is also supported by an accepted understanding of how the development of capabilities takes place over time—due to complex interactions between a firm's resources (Amit & Schoemaker, 1993), leading to a situation where changing a strategy is considered risky and costly, difficult to implement, and may require new measures

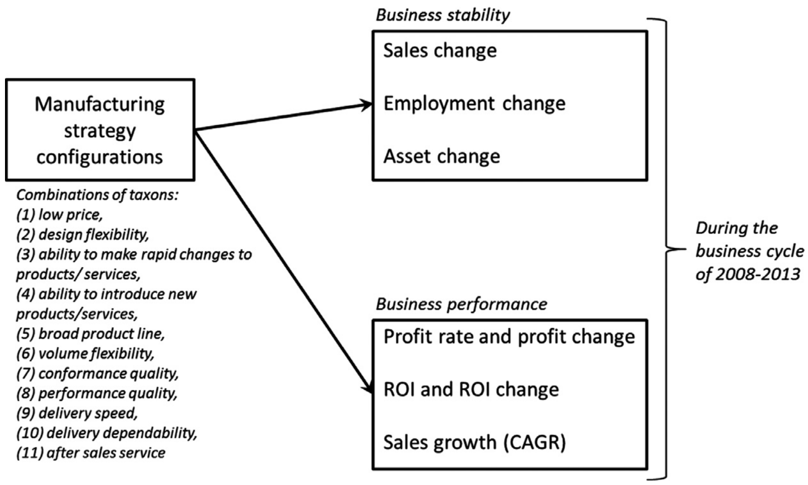

Fig. 1. Research framework.

and considerable investment (Leitner & Güldenberg, 2010). As will be shown later in the analysis, the sample firms in our research do not demonstrate significant changes in terms of their production assets, which here serves as a proxy indicator of strategy persistence within the manufacturing sector. This important assumption essentially permits us to relate post-shock manufacturing strategy configurations, which are the combined results of pre-shock initial conditions and within-shock adaptation, with within-shock business outcome trajectories (see Latham & Braun, 2011).

In terms of business outcomes, we separate this concept into two parts, namely business stability (change) and business performance (level), both of which are affected during the business cycle (Fig. 1). Indeed, as SMEs may prioritise business stability (Kotey, 2005), such as in terms personnel count (Peltonen, 2013) and income stream (Khan & Quaddus, 2015; Morris, Schindehutte, & Allen, 2005), we define this apparently novel construct accordingly as resistance to the implications of macro-economic shocks, such as hiring/layoffs, adjustment in production assets and severe increase/decrease in sales. Furthermore, a manufacturing strategy configuration is proposed as it is considered to influence business performance, which is defined as comprising such measures as sales growth, profit rate, and return on investment, as well as changes in these measures. Similar operationalisations, although with subjective measures, have been recently employed by for example Wang, Dou, Zhu, and Zhou (2015) and Panwar, Nybakk, Hansen, and Pinkse (2015). The methods used for measuring the constructs of the research framework are described in the section on methodology.

3. Research context

Traditionally, Finland has been mostly an export led (due to the small size of the home market) and technology and engineering-based economy (with machine building and ICT as significant industries), demonstrating strong GDP growth rates. However, after the financial crisis of 2008–2009, the environment changed drastically, leading to unfavorable development trajectories, with a low demand for capital goods and high interest rates for manufacturing SMEs, which were coupled with high costs for input factors. At the time of writing, Finnish GDP remained below the 2008 level (in 2014 it was, in real terms, nearly 6% lower; Statistics Finland, 2015), with both imports (−7% in 2014) and especially exports (−15% in 2014) also below the pre-crisis levels of 2008 (Finnish Customs, 2014). Competition from emerging markets, such as China, and the effects of a strong Euro, further increased the plight of Finnish manufacturing SMEs. As Fig. 2 illustrates, the amount of industrial jobs in Finland declined by 27.2% in the period 2000–2014.

Fig. 2 also illustrates revenue development in Finland's four most important export industry sub-sectors. It is clear that the revenue generation of electricity and electronic appliances, metal, and forestry industries was negatively affected by the 2008–2009 economic crises. In our subsequent empirical analysis, we examine the performance of manufacturing SMEs during the period from 2008–2013, drawing on a secondary set of financial performance data.

4. Methodology

4.1. Data collection process and sample

The primary data for this study was collected by using a survey method and an Internet-based survey questionnaire in March and April 2014. The population for this study comprises SMEs and large companies in Finland from 24 industry groups involved in manufacturing (SIC codes 10–33). Non-manufacturing and micro-sized companies (turnover less than 2 million EUR; according to the definition by European Commission) were excluded from the scope of this research. The latter limitation was set in order to achieve a more homogeneous and manageable population of firms that had a more probable interest and resources to participate in the survey. According to the data from Statistics Finland, there were 2541 SMEs and large firms in the manufacturing sector in Finland in the 2013 (population). The companies' contact information was obtained from a commercial database (Intellia; containing information on over 450,000 companies operating in Finland). The eventual contact list included 3751 current email addresses of CEOs and production and/or purchasing managers in 1945 different companies (sampling frame, covering 77% of the population).

In the design of the questionnaire, the extant literature was used to formulate the items in the questions (Bierly & Daly, 2007; Frohlich & Dixon, 2001; Miller & Roth, 1994; Zhao et al., 2006; see later discussion for details), which may be considered tested and valid. The questions were translated into Finnish by the operations management faculty, with consequent peer-to-peer discussion to ensure correctness. Furthermore, the Finnish language questionnaire was pre-tested in a workshop-like setting with a group of managers for ascertaining face and construct validity. In order to avoid common method bias due to item ambiguity, adjustments to question wording and layout were implemented for simplicity and conciseness (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

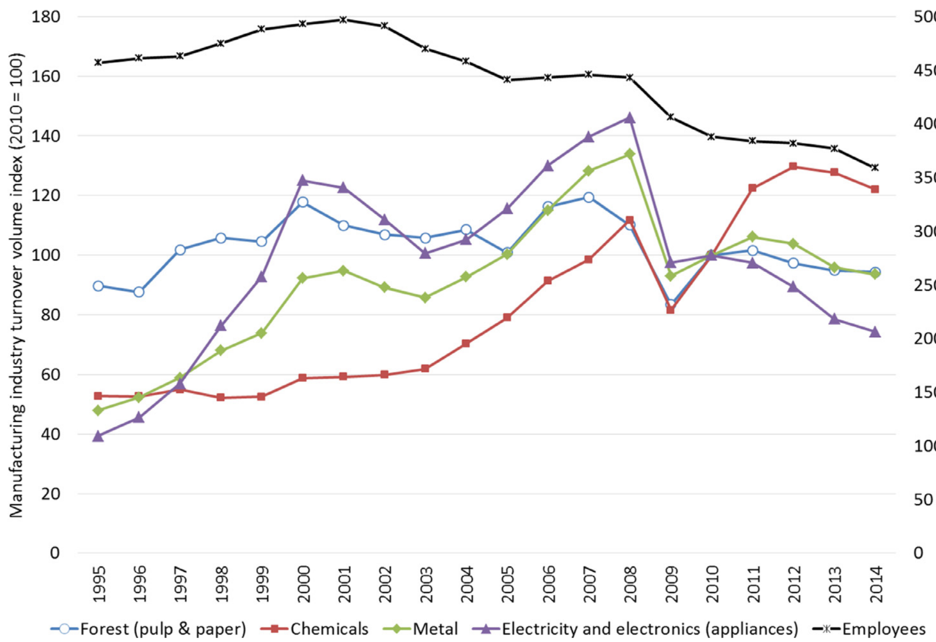

Fig. 2. Employment and revenue development of the manufacturing companies in the four most important sub-sectors of Finnish industry. Data source: Statistics Finland (2015).

Table 1
Frequency distributions of the respondents (SMEs, $n = 190$).

Turnover (2013)			Employees (2013)		
Turnover (millions, €)	Frequency	%	Employees	Frequency	%
2–5	66	34.7	10–25	52	27.4
5–10	38	20.0	26–50	68	35.8
10–20	42	22.1	51–100	37	19.5
20–50	44	23.2	101–250	33	17.4
Total	190	100	Total	190	100

Primary data collection was conducted with a web-survey platform. An invitation to participate in the questionnaire was sent to the 3751 personal email addresses in 1945 different companies, followed a week later by a first reminder message. On the whole, reminder messages were sent to non-responding participants four times, each resulting in diminishing response peaks. If more than one response was received from the same company, the most complete response, or in case of several completes, the one submitted the earliest, was chosen for the sample. In total, 244 valid questionnaires were selected for further analysis, with a response rate of 12.6% (considered typical for e.g. logistics research on a similar scale; Wagner & Kemmerling, 2010). Due to our specific focus on SME manufacturing strategies, we limit our analysis to the SMEs in the sample, and screen out large firms. The share of SMEs among the respondents was 190 enterprises (Table 1).

4.2. Measurements

In order to collect data about the manufacturing strategies of Finnish SMEs, we draw on the extant taxonomic research. Table 2 shows the evolution of the taxons used in previous research, and the reliance of the current study on the revised set of taxons—as suggested by Zhao et al. (2006). In that particular study, the original design flexibility created by Miller and Roth (1994) was broken down into two separate taxons, i.e. the ability to make rapid changes to products and/or services and the ability to introduce new products and/or services. Lastly, broad distribution and advertising were dropped for being marketing-oriented.

Each of the STRATEGY taxon variables were measured on a 1 to 7 Likert scale, with response options ranging from No significance to Critical significance. Also included was the request: Please assess the current significance of the following factors to the company An eighth “No response” option was provided in order to eliminate the possibility of forced assessments.

We use background variables to describe and validate the potential manufacturing strategies defined by the taxonomy. The respondents' turnover (sales) for 2012 was collected from the sampling frame database (TURNOVER, in EUR). We also asked the respondents for their opinions on several statements relating to environmental or market dynamism, the level of innovation, as well as business perspectives (based on Bierly & Daly, 2007). More specifically the following statements were measured on a seven-point Likert scale, ranging from completely disagree to completely agree: (1) the company's markets change faster than average (CHANGESPEED), (2) the company's markets change more unpredictably than average (CHANGEUNPREDICT), (4) the company makes significant investments in new product development (PRODUCTDEV), (5) the company makes significant investments in process development (PROCESSDEV), and (6) business prospects for our company appear positive for the next 12 months (PERSPECTIVES). The corresponding single item measures are used to characterize and validate the eventual taxonomy.

Finally, we used *industry* classifications for each respondent firm, which were provided by the sampling frame database. We recoded the original industry classification variable into a simpler version with less categories, grouping industries as follows:

Table 2
Comparison of the taxons used across the studies (compare with Zhao et al., 2006).

No.	Competitive capabilities	Miller and Roth (1994)	Frohlich and Dixon (2001)	Zhao et al. (2006)	Current study
1	Low price	X	X	X	X
2	Design flexibility	X	X	..	..
2a	Ability to make rapid changes to products/services	..	..	X	X
2b	Ability to introduce new products/services	..	..	X	X
3	Broad product line	X	X	X	X
4	Volume flexibility	X	X	X	X
5	Conformance quality	X	X	X	X
6	Performance quality	X	X	X	X*
7	Delivery speed	X	X	X	X**
8	Delivery dependability	X	X	X	X***
9	After sales service	X	X	X	X
10	Broad distribution	X	..	..	..
11	Advertising	X	..	..	..

* Exact back-translation "superior quality".
** Exact back-translation "short delivery time".
*** Exact back-translation "correct timing of deliveries".

(1) process industry (food and drink, wood, paper, chemical, and pharma; $N = 55$); (2) light industry (textile and apparel, rubber and plastic, mineral products, and furniture; $N = 48$); (3) metal refining and metal products ($N = 45$); (4) machines, appliances and transport equipment ($N = 64$); and (5) computers and electronics ($N = 32$) (see e.g. Dangayach & Deshmukh, 2001). This INDUSTRY category variable allows us to characterize the clusters with a manageable number of variable categories.

In terms of the outcome variables, we relied on a secondary dataset, i.e. publicly available accounting data (accessed via another commercial database; Asiakastieto, 2015), in order to establish business stability and performance patterns for each company during 2008 and 2013, essentially covering a serious recession in the business cycle from 2008 to 2009 as well as its aftermath. Firstly, regarding the measuring of *business stability* in the business cycle, we specify year-on-year change variables in percentage terms for sales (SALESCh; this uses financial year sales divided by the length of financial year in months in order to enable comparisons across firms), employment (EMPLOYCh), and assets (ASSETCh; machines and equipment only), with, for example, sales change from 2008 to 2009 specified as SALESCh08-09. Then we specify downsizing/ramp-up or growth/decline related event-variables, which take the value of the maximum upside or downside change during the observation period (e.g. ASSETChMax, ASSETChMin). After that, we specify the mean of the year-on-year changes during the observation period as for example SALESChMean.

Secondly, for measuring *business performance* during the business cycle, we specify year-on-year changes in percentage terms for profit/loss for the financial year (PROFITCh) as well as return on investment (ROICh). In addition to these relative values, we specify level related variables for profit/loss rate and ROI for each year (e.g. PROFIT08, ROI09 in %), and mean profit/loss rate and ROI for the observation period from 2008 to 2013 (e.g. PROFITMean08-13, ROIMean08-13 in %). Finally, we specify a variable for measuring sales growth for 5 or 6 years (depending on secondary data availability, e.g. from 2008–2013 or from 2009–2013), by using the compound average growth rate (SalesCAGR). We used standard scores to detect and delete influential outliers (thresholds set at 4 and −4).

4.3. Nonresponse and common method biases

In this study the assumptions about the representativeness of the sample are based on two approaches. First, we compare respondents and nonrespondents on characteristics known *a priori*, which is a technique to detect the existence of nonresponse bias (Wagner & Kemmerling, 2010). The nonresponse bias was approached via t-tests comparing key financial indicators, such as turnover, operational profit and profit margin, between respondents and nonrespondents. Statistical significance was based on two-sided tests evaluated at the 0.05 level of significance. A moderate difference between respondents and nonrespondents was observed in the size of companies, i.e. the sample is biased towards the larger variety of SMEs in the sampling frame. Overall, the results support the assumption that there is no significant nonresponse bias in the sample, based on the analysis of known and *a priori* collected secondary financial data.

Second, in addition to the comparison between respondents and nonrespondents, we used extrapolation to examine nonresponse bias (Armstrong & Overton, 1977; Wagner & Kemmerling 2010). Extrapolation is based on the assumption that late respondents may be similar to nonrespondents, and if there is no difference between early and late respondents, generalization is possible. By using this method, no significant differences were found in our sample. Based on using the two techniques to address nonresponse bias, we conclude that our sample is adequate in its representativeness, although a bias towards the larger SMEs is acknowledged.

In terms of the industry composition of our sample, we observe respondents from practically all the manufacturing industries specified by the industry classification system used in Finland. Comparing respondent frequencies as per industry with the population of manufacturing firms, we observe our sample to be biased toward machine building (51 firms, 20.9% of the sample) and electronic appliance manufacturing (32 firms, 13.1% of the sample), whereas metal products manufacturing (45 firms, 18.4% of the sample) are underrepresented. The dominant industries in our sample are the three mentioned in the previous sentence as well as food and drink processing (21 firms, 8.6% of the sample), and timber and wood products manufacturing (16 firms, 6.6% of the sample). The sample therefore adequately represents the Finnish industrial landscape.

Bankruptcies represent a potential survival bias for our research (see e.g. Smallbone et al., 2012). During 2003–2014, the average number of annual exits from business was 299 in the manufacturing sector (peaking at 360 in 2009; Statistics Finland, 2016). We estimate that during 2008–2014, 84% of these exits were, on average, from the micro-sized category of firm, firms with turnover less than 2 MEUR (Asiakastieto, 2015). It should be noted that we do not attempt to cover these micro-sized firms in our sampling frame. Compared to the population of SME manufacturing firms (estimated at an average of about 2141 during the observation period; Statistics Finland), the extent of SME exits from the manu-

Table 3
Descriptive statistics and the correlations for the strategy taxons.

#	Variables (taxons)	Mean	SD	1	2	3	4	5	6	7	8	9	10
1	Low price	5.51	1.12	1									
2	Ability to make rapid changes to p&s	5.55	0.99	0.32**	1								
3	Ability to introduce new p&s	5.09	1.27	0.15*	0.40**	1							
4	Broad product line	4.75	1.11	0.13	0.21**	0.16*	1						
5	Volume flexibility	5.83	0.99	0.25**	0.24**	0.24**	0.11	1					
6	Conformance quality	5.93	0.86	0.16*	0.22**	0.14	0.09	0.24 **	1				
7	Performance quality	5.47	1.02	0.18*	0.21**	0.12	0.23 **	0.15*	0.51**	1			
8	Delivery speed	5.61	0.94	0.32**	0.34**	0.11	0.24**	0.16*	0.24**	0.24**	1		
9	Delivery dependability	6.03	0.89	0.30**	0.34**	0.17*	0.22 **	0.32**	0.43**	0.34**	0.45**	1	
10	After-sales service	4.42	1.40	0.06	0.24**	0.36**	0.28 **	0.01	0.12	0.08	0.12	0.19**	1

p&s = products/services.
* Significant at $p < 0.05$ level.
** Significant at $p < 0.01$ level.

facturing business is estimated to be 2.1% annually. Therefore, with the SME category remarkably resistant to bankruptcy during the crisis and its aftermath, we conclude that there is a low probability of significant survival bias in our sample.

Addressing the possible common method bias in our research (Podsakoff et al., 2003), we consider the following. The primary dataset, which serves as the basis for the taxonomy and characterizes the respondent firms, for example, in terms of market dynamism, and the secondary data, which describes other firm characteristics and performance, are obtained from different sources and this in line with trying to avoid the common method bias by using procedural remedies (Podsakoff et al., 2003). Furthermore, efforts were made to avoid ambiguity in questions and items by pre-testing the questionnaire. We also used Harman's single factor test to assess the extent to which common method variance might be a problem. None is perceived, as five factors emerge from the data including all the Likert-measured variables.

4.4. Methods of analysis

We employ cluster analysis procedure to determine the manufacturing strategy taxonomy of the Finnish SMEs. The cluster analysis has been considered a subjective method; however, our strong conceptual basis improves validity, and the extant research provides ample results for reflecting on our methodological choices and conclusions.

The analysis for the detection of potential outliers does not suggest action to omit any cases from the data. We initially proceeded without the within-case standardization, and there appeared also no need to standardize across variables, as all strategy variables are measured with the same scale (Hair, Black, Babin, & Anderson, 2010). Some of the variables appear correlated (from low to medium; Table 3), suggesting possible multicollinearity and an uneven influence on cluster solution; however, we retain all the variables in order to maintain comparability with prior research.

As all the clustering variables are metric, we follow an approach similar to both Frohlich and Dixon (2001) and Zhao et al. (2006), and use the two-step combination clustering procedure, in which a hierarchical technique is first used to determine the possible cluster solutions and the appropriate number of clusters. We used Ward's method as the hierarchical clustering procedure, as this was also used in the Frohlich and Dixon (2001) study, and as we desire for somewhat equally sized clusters (Hair et al., 2010), in order to enable further analysis. According to the two-step procedure, the resulting outcomes from the hierarchical procedure were input into a non-hierarchical algorithm (K-means).

As Hair et al. (2010) suggests, considering the sample size n, the appropriate number of clusters should be between $n/30$ and $n/60$, i.e. from four to eight in our case. However, to allow us to compare with the classic results of Miller and Roth (1994), we allow for a minimum of three clusters to emerge.

To assess criterion validity we test the prediction power of the cluster membership variable. We make the cluster membership variable the dependent variable and use multinomial logistic regression to explain cluster membership by the means of several independent variables related to the characteristics of the manufacturing SMEs and their context, e.g. size by turnover, level of innovation focus, business perspectives, market dynamism, and industry type. The method makes no assumptions about variable distributions, linear relationships, or equal variance within groups (Tabachnik & Fidell, 2007). For categorical predictors, the change in odds designates the relative risk of being in one of the categories of the independents, relative to the reference group. We also make the categorical cluster membership variable the predictor, and use one-way ANOVA analyses to determine the stability and performance outcome differences among the clusters, thus addressing the primary aim of the research.

5. Data analysis and results

5.1. Taxonomy of the manufacturing strategy types

In the first phase of the cluster analysis, the agglomeration coefficient produced by the hierarchical Ward's method, conducted with a scree-plot, suggests that the average proportionate increase in heterogeneity to the next stage across nine- to two-cluster solution stages is 8.11%. Consequently, as the first higher than average value occurs as solutions move from a five-cluster solution to a four-cluster solution (8.29%), we suggest the five-cluster solution be used as the most feasible stopping point. The scree plot also suggests a major step-increase at this point, giving support for the five cluster solution.

A graphical observation of the mean values for each of the variables as per the five clusters suggests that the data suffers from somewhat significant response-style effects, i.e. the cluster profiles are similar in shape but on different levels of importance (Hair et al., 2010). Due to this effect, respondents may be classified as yea-sayers or nay-sayers or something in between (cf. Boyer & Lewis, 2002; see also the discussion on the effects of positive/negative affectivity or the transient mood states of the respondents by Podsakoff et al., 2003). The clustering algorithm appears to attach to these seemingly significant patterns, rather than the differences in actual strategy, i.e. the perception of capability importance. To test this observation, we observed the bivariate correlation analysis on all the STRATEGY variables (taxons), gaining results that suggest positive correlations in all of the 45 bivariate relationships, with 34 of those being statistically significant (Table 3).

To overcome the response-style effect, we used within-case standardization by dividing each clustering variable value by the average of all clustering variable values (for each respondent; as suggested by Hair et al., 2010; a similar approach has also been successfully used by Boyer & Lewis, 2002). A rerun of bivariate correlation analysis suggests 19 statistically significant positive and negative correlations, the remaining being both positive (11) and negative (15). Most importantly, there appears to be a trade-off between volume flexibility and after-sales services (−0.370, $p < 0.01$), as well as between the ability to introduce new products/services and the time related taxons of delivery speed (−0.303, $p < 0.01$) and delivery dependability (−0.301, $p < 0.01$). The results appear to be aligned with literature that highlights the challenges of achieving flexible service capacity under highly variable demand (Klassen & Rohlehder, 2001) and reconciling the trade-off between product performance and time-to-market (Cohen, Eliasberg, & Ho, 1996), suggesting a strong case for using the within-standardized variables in future analyses.

The rerun of the hierarchical cluster algorithm with the within-standardized variables produces a scree-plot, which again suggests the five-cluster solution as the stopping point (the proportionate increase in heterogeneity to the next stage is 7.73%; above the average of 7.40). Further examination reveals that the rerun analyses produce a cluster with only one case. This case is screened from further analysis, and the rerun analysis and the resulting scree-plot suggest a four-cluster solution as there is an adequate number of cases in each cluster (23, 94, 23, and 39).

Therefore, the four-cluster solution is chosen for further analysis. The examination of the taxon means and the resulting cluster profiles suggests that the within-case standardization effectively remedies for the response-style effects. This is an important consideration in the discussion of the results in the light of previous research, in which remedies for response-style effects appear not to have been used, and which suggests such types as all-around high or low performers (Frohlich & Dixon, 2001; Kathuria, 2000; Zhao et al., 2006).

In the second phase, we proceed to conduct the K-means non-hierarchical analysis, and resort to the random initial seeds suggested by SPSS software within an optimization algorithm that allows for the reassignment of observations among clusters until a minimum level of heterogeneity is reached. The forced four-cluster solution suggests three larger clusters with 50, 40 and 89 cases and a cluster of one. We therefore finally settled for the three cluster solution (the cluster with one case was discarded).

The stability of the final solution was assessed by sorting the data by the variable TURNOVER, rerunning the non-hierarchical analysis and cross-tabulating by the pre-sort and post-sort cluster membership categorical variables—in order to detect switches in cluster membership. The analysis suggests that the three-cluster solution is relatively stable with only 12% of the cases reassigned to a different cluster in the post-sort solution.

Table 4 presents the variable means and ranks by cluster. One-way ANOVA analyses suggest that there are statistically significant differences among the means for each cluster ($p < 0.05$, except for ability to make rapid changes to products and services with $p < 0.10$), indicating that the cluster solution discriminates adequately between the cases in our sample.

Further graphical examination of the clusters in terms of the taxon means also allows us to attempt to profile the clusters (Fig. 3). For Cluster 1, the top two capability areas are volume flexibility and delivery dependability, whereas the bottom two are after sales service and broad product line. Based on visual observations, Cluster 1 appears to differ from the other clusters most in terms of its incumbents' high emphasis on new product and service development (which is statistically different from the others, based on ANOVA post-hoc tests at the $p < 0.05$ level), as well as on the ability to change products and services and change volume flexibly. This cluster also has the lowest emphasis on the ability to offer a broad product line (which is statistically different from the others based on ANOVA post-hoc tests at the $p < 0.05$ level).

With its profile, Cluster 1 does not readily conform to any of the manufacturing strategy clusters identified by prior taxonomic research. Perhaps the closest relative can be found in the Innovators cluster identified by Miller and Roth (1994) as delivery dependability and design flexibility are similarly emphasised. However, Cluster 1 is much stronger in volume flexibility, which characterises the Mass servers identified by Zhao et al. (2006), although they also emphasize a broad product line. Due to our weak alignment with prior research, we resort to naming our Cluster 1 as Responsive niche-innovators, which might describe companies experiencing significant market change and short product life-cycles.

The top two capability areas for Cluster 2 are conformance quality and delivery dependability, whereas the bottom two capability areas are after-sales service, as well as the ability to introduce new products and services, which contrasts with the ability to change product and service design. Cluster 2 differs from the other clusters due to its strikingly low emphasis on new product and service development (which is statistically different from other ANOVA post-hoc tests at the $p < 0.01$ level), and there is also a higher emphasis on the two time-oriented and the two quality-oriented capabilities (which is statistically different from other ANOVA post-hoc tests at the $p < 0.05$ level).

Consequently, Cluster 2 bears a similarity to the Marketeers cluster identified by Miller and Roth (1994), which also emphasizes quality and time/speed, i.e. a marketable production process, as well as some degree of ability to compete with low price. Cluster 2, however, places more emphasis on volume flexibility as product and service change flexibility are also relatively high. The profile is also somewhat similar to the Specialized Contractors discovered by Zhao et al. (2006) because the emphasis on new product and service design capability is very low, but a low price and a marketable production process are emphasized. Aligning ourselves with Zhao et al. (2006), we name Cluster 2 Subcontractors.

Similarly to Cluster 2, Cluster 3 emphasizes delivery dependability and conformance quality as the top two capabilities, while assigning after sales service and broad product line to the bottom two. However, in comparison to the other clusters, Cluster 3 places the most emphasis on the generally shunned capabilities of offering a broad product line, which is perhaps an indication of higher than average customization capability, and providing after-sales services (the latter being statistically different from other ANOVA post-hoc tests at the $p = 0.01$ level). In comparison to the other clusters, Cluster 3 places the least emphasis on a low price and volume flexibility (both being statistically different from other ANOVA post-hoc tests at the $p = 0.01$ level).

The profile appears to be aligned with the Quality customizers identified by Zhao et al. (2006), who also emphasize quality and design flexibility. A similarity can perhaps also be seen with the cluster found in Western Europe by Frohlich and Dixon (2001), which is called Designers and which emphasizes quality and after-sales service, while volume flexibility and low price receive less emphasis (see also Servers). As the profile hints at engineer-to-order, project-based and capital equipment production, we name Cluster 3 Engineer-servers.

5.2. Validation of the manufacturing strategy taxonomy

In the multinomial logistic regression analysis, Engineer-servers (Cluster 3) as the largest category of a new variable MANSTRAT-CLUSTER (a category variable determining cluster membership), was chosen as the reference category. The analysis was conducted with the independent variables of TURNOVER2012, INDUS-

Table 4
Mean values and ranks for the three clusters of the four-cluster solution.

Means (ranks) and ANOVA results No.	Variables (taxons)*	1	2	3	F	Sig.
1	Low price	1.079 (4)	1.064 (6)	0.960 (8)	9.177	0.000
2	Ability to make rapid changes to p&s	1.061 (6)	0.986 (7)	1.020 (4)	2.989	0.053
3	Ability to introduce new p&s	1.066 (5)	0.674 (9)	0.980 (6)	86.08	0.000
4	Broad product line	0.759 (9)	0.896 (8)	0.931 (9)	16.37	0.000
5	Volume flexibility	1.171 (1)	1.110 (4)	1.012 (5)	17.03	0.000
6	Conformance quality	1.103 (3)	1.196 (1)	1.052 (2)	15.84	0.000
7	Performance quality	0.992 (8)	1.130 (3)	0.966 (7)	16.21	0.000
8	Delivery speed	1.015 (7)	1.097 (5)	1.022 (3)	4.347	0.014
9	Delivery dependability	1.107 (2)	1.182 (2)	1.087 (1)	7.699	0.001
10	After sales service	0.646 (10)	0.664 (10)	0.811 (10)	80.05	0.000
	Cluster size (N)	50	40	89		

* Within case standardised variables p&s = products/services.

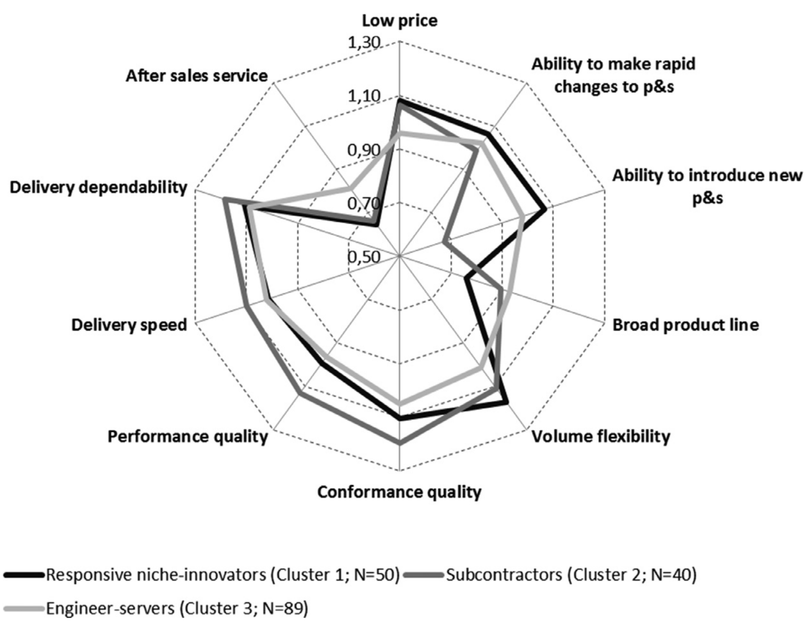

Fig. 3. Profiles for the final three cluster solution, based on taxon means (p&s = products and services).

TRY, CHANGESPEED, CHANGEUNPREDICT, PRODUCTDEV, PROCESSDEV, PERSPECTIVES to find the most suitable model through an automatic backward elimination procedure. The threshold for excluding a variable was set at $p = 0.05$. Based on the chi-square test ($p = 0.000$), we can reject the null hypothesis that all the regression coefficients are equal to zero, i.e. the final model, with the remaining variables, improves upon the intercept only model.

The backward elimination procedure suggests a model with three statistically significant independent variables, namely TURNOVER ($p = 0.000$), INDUSTRY ($p = 0.020$), and PRODUCTDEV ($p = 0.004$). Apparently, environmental or market dynamism does not differentiate the clusters in our sample. Based on the model parameter estimates presented in Table 4, we can reject two test-based null hypotheses, i.e. parameter estimates equal zero, in the Responsive niche-innovator (Cluster 1) category of the MANSTRATCLUSTER, namely TURNOVER2012 ($p = 0.000$) and the Electronics category of INDUSTRY ($p = 0.045$). Similarly, for Subcontractors (Cluster 2), the parameter estimates appear non-zero for PRODUCTDEV ($p = 0.006$) and the metal category of INDUSTRY ($p = 0.034$).

The column *Exp(B)* in Table 5, presents the odds ratios for the predictors. For the statistically significant (at the 0.05 level) coefficients, odds ratios may be greater or less than one, implying that the risk of the outcome, i.e. the cluster membership, falling in the comparison group, i.e. Cluster 1 or 2, relative to the risk of the outcome falling in the referent group, i.e. Cluster 3, increases as the predictor variable increases or decreases, respectively. With the odds ratio of TURNOVER2012 being exactly 1, it appears that as turnover increases, there is a similar risk of falling into either cluster 1 or 3. More interestingly perhaps, it appears that the higher the emphasis in a company on new product development, the lower the risk the company has of falling into the Subcontractors cluster. It is therefore more likely that companies with an emphasis on product development are among the Engineer-servers (Cluster 3), a result that validates the earlier cluster analysis results (see Fig. 3 and the discussion of the cluster profiles).

Similarly, for the categorical INDUSTRY variable, the analysis suggests that companies that manufacture computers and electronics are less likely to fall into Cluster 1 than Cluster 3, i.e. the Engineer-server cluster, which is more computers and electronics manufacturing oriented. Second, companies in metal refining and metal products manufacturing industries are more likely, by a factor of 3.625, to fall into the Subcontractor cluster (Cluster 2). This latter finding supports our conclusion on the characterization of Subcontractors, which is based on the most recent (2011) input-output tables of the Finnish economy (Statistics Finland 2014) and finds that metal refining companies and the manufacturers of metal products (the supplier industry) sell most of their output in monetary terms to machine building companies (a customer industry). In this industry level supply chain, the Subcon-

Table 5
Parameter estimates for the model.

MANSTRATCLUSTER reference category is ‘Engineer-servers’ (Cluster 3)	B	Std. Error	Wald	Df	Sig.	Exp(B)	
‘Responsive niche-innovators’ (Cluster 1)	Intercept	0.223	0.793	0.079	1	0.779	..
	TURNOVER2012	**0.000**	**0.000**	**14.563**	**1**	**0.000**	**1.000**
	INDUSTRY (process)	0.394	0.580	0.463	1	0.496	1.484
	INDUSTRY (metal)	0.033	0.610	0.003	1	0.956	1.034
	INDUSTRY (electron.)	**−1.568**	**0.784**	**4.003**	**1**	**0.045**	**0.208**
	INDUSTRY (machines)	−0.812	0.582	1.942	1	0.163	0.444
	INDUSTRY (light)	0[a]	..	..	0	..	..
	PRODUCTDEV	0.102	0.145	0.494	1	0.482	1.107
‘Sub-contractors’ (Cluster 2)	Intercept	0.659	0.715	0.849	1	..	..
	TURNOVER2012	0.000	0.000	0.248	1	0.619	1.000
	INDUSTRY (process)	0.074	0.708	0.011	1	0.917	1.077
	INDUSTRY (metal)	**1.288**	**0.607**	**4.499**	**1**	**0.034**	**3.625**
	INDUSTRY (electron.)	−0.080	0.834	0.009	1	0.923	0.923
	INDUSTRY (machines)	0.111	0.641	0.030	1	0.863	1.117
	INDUSTRY (light)	0[a]	..	..	0	..	..
	PRODUCTDEV	**−0.397**	**0.145**	**7.500**	**1**	**0.006**	**0.673**

[a] This parameter is set to zero because it is redundant.

tractor cluster suppliers are likely to manufacture machine components that are specified and subcontracted by Engineer-server type customers in Cluster 3. Indeed, further analysis, conducted with the categorical machine building supply chain variable (1 = machine building, with transport equipment excluded; 2 = metal refining and products; 0 = others; based on the secondary data on industry membership), suggests that the Engineer-server cluster is more likely to host companies in the machine building industry than the metal products companies. In conclusion, it appears that environmental or market dynamism does not differentiate the manufacturing strategy configurations in our sample, whereas the configurations seem partly determined by the industry, value chain position, and product development emphasis.

5.3. Business outcomes of the manufacturing strategy configurations during a macroeconomic shock

We first consider differences in business stability among the clusters during the macroeconomic shock and its aftermath. From the general picture, given by Fig. 1, it can be observed that the period between 2008 and 2009 was the most difficult for many industries, with severe declines in turnover. Varying degrees of recovery took place in 2010, whereas moderate decline persisted from 2011 onwards.

ANOVA analyses with LSD post-hoc tests on all the stability related change-variables suggest the following. First, it appears that the negative sales change from 2008 to 2009 (SALESCh08-09) was deeper for Subcontractors (−25%) than Engineer-servers (−14%; $p < 0.05$; Responsive niche-innovators at −16%), which suggests a lack of recession-proofing in the Subcontractor manufacturing strategy configuration.

Second, in terms of employment, the closest we get to a statistically significant result for cluster differences regarding the change in employment is for 2008–2009 (EMPLOYCh08-09) when Engineer-servers appear to make fewer employees redundant (−2%) in comparison to Responsive niche-innovators and Subcontractors (both at −7%; $p = 0.126$ and $p = 0.116$, respectively). While the risk of false positives is higher than normally accepted, we note the weak signals indicating that Engineer-servers are more stable in severe recessionary periods. No change in terms of production assets was observed in the data.

The analysis now turns to the business performance related level variables, which focus on sales growth, profit rate and return on investment. The ANOVA analysis with LSD post-hoc tests suggests the following. First, in terms of five or six period sales growth, there appears to be no statistically significant differences between the clusters (SalesCAGR is +2%, −0.1%, and +1% for Responsive niche-innovators, Subcontractors and Engineer-servers, respectively).

The mean profit rate 2008–2013 (PROFITMean08-13) appears to be higher for Engineer-servers (+4%) in comparison to Responsive niche-innovators (+0.2%) $p < 0.01$) and Subcontractors (+1%; $p < 0.05$). In terms of profit change, which is perhaps more interesting as industry profit differences should not play a significant role, the ANOVA analysis with an LSD post-hoc test suggests that the negative profit change 2008–2009 (PROFITCh08-09) has been deeper for Subcontractors (−5%) than Engineer-servers (−2%; $p < 0.10$).

Mean ROI during 2008–2013 (ROIMean08-13) is higher for Engineer-servers (+14%) than Responsive niche-innovators (+9%) $p < 0.05$) and Subcontractors (+11%; $p < 0.05$). When observing changes in ROI, the analysis suggests a higher positive ROI change 2009–2010 for Responsive niche-innovators (+9%) than for Engineer-servers (−0.2%; $p < 0.05$), underscoring the rebound capability of Responsive niche-innovators in a period of brief recovery. It should be noted that ROICh in the previous period (2008–2009) was −11% for Responsive niche-innovators, −13% for Subcontractors, and −9% for Engineer-servers.

6. Discussion

Our research suggests that three distinctive manufacturing strategy configurations can be observed among the SMEs of the Finnish manufacturing sector, namely: Responsive niche-innovators (Cluster 1), Subcontractors (Cluster 2), and Engineer-servers (Cluster 3). The discovery of these clusters reflects the characteristics and composition of the SME manufacturing sector in Finland, which is dominated by the members of a machine building supply chain, and therefore emphasizes the role of the business context, such as dominant industries and competitive pressures, in shaping manufacturing strategy configurations that are found in different countries and regions. In general, our findings are in line with the theory that the value of a firm's capabilities depend on the context as much as on the properties of the assets themselves (Miller & Shamsie, 1996; Priem & Butler, 2001; Wan, 2005).

This conclusion also aligns with previous research, e.g. by Zhao et al. (2006), whose clusters clearly reflect the Chinese context. Our context of a small developed economy, with high input costs and a limited domestic market, may be thought to have also contributed to the evolution of the manufacturing strategy configurations of SMEs (cf. Noble, 1995), which have perhaps advanced to some degree from a low price focus to the present day configurations, which include flexibility, product and process innovation, as well as after sales service provision. These have been shown to provide performance benefits in contexts characterized by dynamism (Anand & Ward, 2004; Swamidass & Newell, 1987), competition (Schroeder et al., 2002), and product commoditization (Kastalli & Van Looy, 2013), respectively.

The firms in the cluster of Responsive niche-innovators appear to be able to combine volume flexibility with design flexibility (innovation), although with narrow product lines. The firms in this cluster are smaller in comparison to the firms in other clusters and have a focus on seemingly lighter industries. The innovation and design flexibility capability does not appear to protect firms in this cluster from the demand shock as relatively high downsizing adjustments took place in terms of employment. However, what is notable for this cluster is the comparatively better capability to rebound from the recession with the best positive ROI change in the post-slump period of 2009–2010, indicating the benefits of the characteristic of responsiveness. However, the average profit and ROI 2008–2013 were comparatively low.

Regarding the Subcontractors cluster it can be observed that these firms place an emphasis on basic capabilities such as quality, delivery and cost, i.e. a marketable manufacturing process (see Miller & Roth, 1994). Both the configuration profile and the analysis of the determinants of cluster membership suggest that these firms place relatively less emphasis on new product development. These firms are also likely to be found in the upstream echelons of the machine-building supply chain. In terms of stability, Subcontractors experienced the largest demand and profit rate decreases during the crisis, and may have also been forced to make comparatively more employees redundant. Mean profit and ROI are also relatively low, especially in comparison to the third cluster. The difference cannot be explained away by size differences because the average size of the firms in this and the third cluster is similar.

The third cluster of Engineer-servers comprises firms with an emphasis on design flexibility, a broad product line, and after-sales service. The firms in this cluster are likely producers of electronics, machines and other equipment, and are thus more likely to be found in the downstream echelons of machine-building supply chains. The downside adjustment of the sales and profit rate during the crisis was the lowest in this cluster, with possibly less of an employment impact as well. Furthermore, both the average profit and ROI were found to be higher in this cluster. Hence, it appears therefore that Engineer-servers enjoyed the most business stability and best business performance during the macroeconomic shock, suggesting evidence of the benefits of their strategy configuration.

Overall, the results appear to suggest support for our P1. The Engineer-server profile, due to its emphasis on design flexibility, services and broad product line, appears able to weather macroeconomics shock better than the other profiles, returning, on average, the highest profit and ROI for owners. The Responsive niche-innovators also appear able to benefit from their emphasis on volume flexibility and are able to capture opportunities in the post-recession context (Kovach et al., 2015; Roberts, 2003; Upton, 1994). It should be noted, however, that due to our limited observation period we cannot, in a strict sense, make statements about the superiority of manufacturing strategies during “bullish” periods, as our results apply to recessionary-shocks and the periods of recovery immediately after the crisis.

7. Conclusions

Our results contribute to the body of research on manufacturing strategy in several important ways. First, the importance of context has indeed been previously explored in operations management literature, although the emphasis has been on environmental dynamism related to markets (e.g. Ward & Duray, 2000) and the manufacturing and supply network configuration context (e.g. Srai & Gregory, 2008). In this paper, we have been able to establish a manufacturing strategy configuration taxonomy for SMEs in a small and developed economy and in a context of severe economic shock. The result is distinctive enough from the configuration taxonomies suggested by prior research to warrant the conclusion that the nature of manufacturing strategy configuration taxonomies is driven by the context. Consequently, it can be argued that universally applicable taxonomies may not exist. However, common configuration characteristics, such as the marketable manufacturing process orientation, or the innovation (design flexibility) orientation may be found across contexts.

Second, this research has been able to link the manufacturing strategy taxonomy-based cluster solution with objective business stability and performance measures from secondary sources. This is important finding as such for expert and intelligence system development alone. It is important to take this into account in credit rating applications (Derelioglu & Gürgen, 2011; Li et al., 2016) and funding decisions (Sohn et al., 2007), as essentially, different clusters vary in terms of stability and performance in uncertain environments, i.e. manufacturing SMEs are not one homogenous group. This may have been what Gordini (2014) had in mind when he stressed the importance of seeing behind the numbers in bankruptcy prediction.

The fact that the above mentioned linkage has been elusive in previous attempts, which have used the taxons of Miller and Roth (1994), may have been caused by a failure to remedy for the response style bias, which possibly caused clustering algorithms to suggest such groups of firms as Idlers and Designers (Frohlich & Dixon, 2001) or Low Emphasizers and Mass Servers (Zhao et al., 2006). In such groups, the emphasis has been suggested as being either low or high across the priorities. In general, we question the view that large bodies of firms, without a clear emphasis on any of the manufacturing strategy dimensions, could survive in today’s competitive context. The within-case standardization of competitive priority variables appears to be a potential enabler for establishing a link between strategy types and business performance, as has been suggested by Boyer and Lewis (2002). Research that seeks to replicate our results, should consider the possible response style bias occurring in the empirical data and apply appropriate standardization as a remedy.

Third, and most importantly, our results seem to point out that such “order qualifying factors” as conformance quality and delivery provide less support for competitive advantage during macroeconomic shocks. This is in comparison to the more likely “order winning factors” like volume flexibility, design flexibility, and service provision. The latter are perhaps more advanced, and not so easily achievable dimensions of manufacturing strategy configurations, and thus appear better able to sustain firms, even during the severe conditions of macroeconomic shocks. These factors also contribute to business resilience (Smallbone et al., 2012), enabling SMEs to overcome vulnerability and survive or even thrive during and after economic downturns. This finding has implications on intelligent systems for evaluating SME funding decisions (Sohn et al., 2007), where used technology and achieved customer relationships are often only superficially dealt with, not taking long-term and strategic view into account.

We delineate the practical implications of this research for different stakeholders. First, for managers, we point out the importance of considering the formulation and development of manufacturing strategy configurations that include volume and design flexibility capabilities, as well as offerings that include service components, such as after-sales, customer process support, research and development, and process operation services (Gebauer, 2008). In other words, although viable machine-building supply networks, for example, should necessarily include subcontractors of components and subassemblies, even these actors in the network should strive towards upgrading basic offerings to more value-added solutions (see e.g. Matthyssens & Vandenbempt, 2008). Such 'more mature' strategies would make manufacturing firms more stable and better performing even under adverse economic conditions. Second, owners, investors, and creditors, may consider our results and consequently make better decisions and more explicit demands for strategy adaptation. Third, we identify actionable priority for policy-makers and regional development organisations, who seek to support their respective populations of manufacturing SMEs. The empirical evidence from our research makes the case for strategy renewal and capability development in SME manufacturing firms even stronger.

Future research on the subject may replicate our research design in other contexts, such as geographical region and business cycle, or develop them further by, for example, employing a longitudinal approach and controlling for strategy persistence in the sample firms (Leitner & Güldenberg, 2010). Future research may also develop the taxon set further by more fully integrating the various servitization elements.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.eswa.2016.09.016.

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