

# Aligning Product Variety with Supply Chain and Business Strategy

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## Abstract

**Purpose** - The study aims to demonstrate the strategic alignment between product variety and supply chain focus through cost leadership or differentiation to improve business performance.

**Design/methodology/approach** - The research investigated product variety-related capabilities and strategies in supply chains including level of variety, supply chain agility, supply chain cost efficiency, cost leadership, differentiation and business performance, and aimed to justify the theory by testing structural equation modelling using survey data from the UK and South Korea.

**Findings** - Differentiation links high product variety and agile supply chain while cost leadership is aligned with low product variety and supply chain efficiency. High product variety negatively impacts on cost leadership strategy. Also, product variety should be mediated by cost leadership or differentiation strategy to improve business performance. Companies in South Korea display higher supply chain agility, cost leadership and cost efficiency than companies in the UK, while the UK companies exhibit a higher level of product variety and differentiation than those in South Korea.

**Research implications** - The findings contribute to theoretical development of variety issues at the alignment of business strategy and supply chain management according to the level of product variety.

**Originality/value** - The findings can help international companies set up specific variety-related strategies to achieve global competitiveness.

**Keywords** - Product variety, Supply chain, Business performance, Structural equation modelling

**Paper type** – Research paper

## **1. Introduction**

Globalisation promotes the need to customise products and services according to the target market or country, and provision of product scope is an issue in deciding if globalisation raises marginal variety's profit (Qiu and Zhou, 2013). Deregulation of trade with supporting technologies has promoted global markets, so manufacturers are required to appropriate strategies in order to provide product variety to different markets. In addition, a noticeable movement for manufacturers is to extend the variety of their products to provide more options for customers in today's challenging global markets. Consumers can match their needs and preferences with the product variety provided by manufacturers (Lancaster, 1990). For example, mega-stores such as Tesco and Wal-Mart provide wide product variety in their quest to provide value to consumers, enabling the stores to improve market share and revenue. Some researchers stress the advantages of product variety based on long-tail theory (Anderson, 2006; Zhou and Duan, 2012), that product variety can improve sales, while others criticise high levels of variety provision mainly due to cost increase. Also, an excess of product information and provision can result in selection confusion for customers and lead to forecasting difficulty for manufacturers (Wan *et al.*, 2012). For example, the market share of Aldi keeps growing, focusing on cost leadership with low product variety, while Tesco have lost their market share to an increasing number of low-cost providers. From the operations perspective, an increase in product variety incurs a cost burden due to diseconomies of scale in the supply chain (SC). The emergence of a global SC has detonated the trade-off between provision of product variety and supply chain performance. Increases in product variety in the global SC incur both production costs and market mediation costs (Randall and Ulrich, 2001). Also, global purchasing and logistic costs increase with product variety provision. High-variety ambitions need to be

profitably achieved without severe deterioration of SC performance, especially considering the cost profile.

Many manufacturers have recognised that a trade-off exists between product variety and SC performance (Fisher and Ittner, 1999; Thonemann and Bradley, 2002; Um *et al.*, 2017). Thus several researchers (Yeh and Chu, 1991; Blecker and Abdelkafi, 2006; Scavarda *et al.*, 2010; Patel and Jayaram 2013) have investigated how to mitigate the impact of product variety on the cost profile of SC processes. Modularity, cellular manufacturing and postponement, typical of functional-level management such as SC integration (Scavarda *et al.*, 2010; Um *et al.*, 2017), SC flexibility and agility are essential in responding quickly to diverse customer needs and improving cost efficiency (Fisher *et al.*, 1999; Swafford *et al.*, 2008). Supply chain flexibility and agility-based management activities in particular have been emphasised to satisfy their high-variety provisions and ambition (Um *et al.*, 2017). In addition, partnerships with suppliers (Tummala *et al.*, 2006; Cousins *et al.*, 2011) and close customer relationships (Child *et al.*, 1991; Wang and Feng, 2012) can be requisite criteria when the manufacturer considers a high level of product variety or the introduction of new products. Thus, business performance such as sales growth and SC performance including cost efficiency and customer service are influenced by the level of product variety provision and focused strategies such as cost leadership or differentiation by individual manufacturers. Theoretically, a high level of product variety environment employs a differentiation strategy to enhance customer service, while a low level of product variety environment considers the cost leadership policy resulting in cost efficiency (see Agarwal *et al.*, 2006; Stavrulaki and Davis, 2010). However, most of the empirical studies on the relationship between product variety and business performance have dealt with potential mitigation strategies or functional approaches without explicitly

considering the strategic alignment of supply chain and business strategies involved with product variety issues.

The level of the existing product variety reflects the organisation's strategic goals and movement. Therefore, all variety-related management capabilities including customisation (i.e. from make to stock to design to order), cost leadership and differentiation, and performance including SC cost efficiency, agility and business-related performance, can differ according to the different level of product variety provided by manufacturers. Also, variation is extended to the national level based on the theoretical approaches in managing variety concerns. The fundamental question relates the matching level of variety offered with organisational or national focus and its reflective strategies. For example, based on the product types (Fisher, 1997) or level of customisation and product variety (Agarwal *et al.*, 2006; Stavrulaki and Davis, 2010), manufacturers are required to focus on either lean, agile or leagile supply chains (Lee, 2002).

The main objective of this study is to explore the appropriate alignment of product variety with business and SC strategy. Then, the research tests findings by comparing the differences between UK and Korean manufacturers in the level of product variety, management strategies and performance. The study also explores the structural process to achieve better business performance. This is achieved by evaluating differences in the level of variety and variety-related strategies including cost leadership and differentiation, and performance including SC agility and cost efficiency. Inspired by literature reviews on product variety and SC performance-related research (see Porter, 1977; Randall and Ulrich, 2001; Stavrulaki and Davis, 2010; Agarwal *et al.*, 2013), the study also examines how differences in product variety between the UK and Korea influence SC strategies and performance from global perspectives. The UK and Korea have different economic backgrounds and outputs, such as economic growth rates (i.e. 1.8 vs. 2.8 %), GDPs (i.e.

2,868 vs. 1,147 billion \$), trade volume (i.e. 674 vs. 527 billion \$ in exports), inflation rates (i.e. 1.8 vs. 1.1 %) and income distribution (i.e. 0.32 vs. 0.30 in Gini coefficient) (International Monetary Fund, 2016; Central Intelligence Agency, 2016). Therefore, the data was collected from two countries that have different economic backgrounds for a cross-examination to generalise the research outcomes better in the global business environment. The key aims for this study are to identify: 1) appropriate alignment of business strategies with product variety in the supply chain; 2) the relationships between variety-related factors responsible for improving business performance; and 3) the differences in product variety, and supply chain performance, that exist between the UK and Korea, suggesting the appropriate supply chain implications for companies in each country.

The research makes two significant contributions. First, it establishes the relative extended theory of product variety management at corporation and national level. A corollary of this contribution concerns the subsequent implications for company strategies and policy. Secondly, the research findings from manufacturers explain how different levels of product variety can impact on business performance positively within the SC. The findings also suggest important managerial and practical alignment for the adoption of different approaches to product variety under different strategic backgrounds, from the perspective of manufacturers.

## **2. Research background and development of hypotheses**

### *2.1 Product variety and supply chain performance*

The term ‘product variety’ is employed by academics and industry with a number of different conceptual meanings (Stablein, Holweg and Miemczyk, 2011). Thus the concept and scope of product variety must be defined clearly. For example, variety can be defined

as a number or collection of different things of a particular class of the same general kind, and product line breadth refers to the stock-keeping units (SKUs) within a brand category. (Elmaraghy *et al.*, 2013). Therefore, increase in product variety refers to the introduction of new products and can be calculated as the number of Stock Keeping Units (SKUs) in the supply chain (Wan *et al.*, 2012). MacDuffie, Sethuraman and Fisher (1996) and MacDuffie *et al.* (1997) defined it to refer to company choices about the breadth and depth of different product lines using three dimensions for types of variety: 1) fundamental (i.e. different core models and designs at the fabrication and design stage), 2) intermediate (i.e. different technical options dependent on core design at the assembly stage), and 3) peripheral (i.e. particular options and accessories independent of core design at the distribution and sales stage). Such an explanation is a reference to internal variety that is generally regarded as the variance involved in creating the product within a firm or SC. On the other hand, external variety is the extent of different and distinguishable products offered by manufacturers in the marketplace that is available to the end consumers. This study employed internal variety based on the concept of MacDuffie *et al.* (1997) from the perspective of manufacturers, considering potential varieties the manufacturers are able to provide.

There is a robust relationship between product variety and the SC cost escalation (Scavarda *et al.*, 2010). A more cost-efficient provision of product variety can generally be attained through three operations strategies: 1) use of the modularity concept by changes in product architecture, which can result in minimising the complexity and associated cost in SC functions (see Forza and Salvador, 2002; Holweg and Pil, 2004; Caridi *et al.*, 2012); 2) flexibility in the operations process using group technology (see Child *et al.*, 1991; Berry and Cooper, 1999); and 3) postponement strategy which delays product configuration decisions in the SC process, such as form and time postponement (Holweg and Helo,

2014). However, since functional-level strategies suggested do not cover the entire SC, the level of product variety should be matched with organisational SC strategies in advance. For example, stock-outs that result from a high product variety strategy may ultimately hurt sales performance (Wan *et al.*, 2012).

Beamon (1999) developed a SC performance framework through a mixture of measures, and suggested three systemic types of performance as critical components: resource, output and flexibility. The resource measure refers to a high level of SC efficiency (e.g. the total costs of resources, inventory, manufacturing, distribution in the supply chain) while the output measure refers to a high level of customer service (e.g. customer satisfaction, customer response times, on-time deliveries, order fill rate, customer complaints, backorder/stock-out, manufacturing lead time, and shipping errors). Many organisations are endeavouring to capture the benefits of flexibility in supply chains (Gopal and Thakkar, 2012). Supply chain flexibility is the internal capability for responding to the changing environment at the functional level. Its attributes are three fundamental processes: procurement, manufacturing and distribution flexibility (Swafford *et al.*, 2006). However, agility represents an externally focused competence concentrating more on speed at the business level, such as market responsiveness, delivery reliability, lead time, product customisation and frequency of product introduction (Swafford *et al.*, 2008). Therefore, supply chain flexibility such as change delivery time, production volume, production mix, delivery schedule and implementation of emerging change can be regarded as an important antecedent of SC agility. Agility itself is a dynamic capability concerned with speed in unpredictable markets with significant demand turbulence to achieve better customer service. Therefore, the role of SC agility should be stressed in the high product variety environment. This study adapts the concept of SC cost efficiency from Beamon (1999) and SC agility from Swafford *et al.* (2008) respectively.

## 2.2 Research model and hypotheses

Theorising seeks to produce findings grounded in evidence and geared toward understanding how relations lead to results, and it extends knowledge (Theodore *et al.*, 2017). One obvious piece of evidence is that product variety and provision of customer options have developed for companies to increase sales volume and market share; however, companies need to accept cost increase in SC and employ appropriate SC strategies to mitigate the impact of product variety. In short, based on the level of product variety, SC strategy and competitive criteria can differ between manufacturers, which can impact on business performance differently. For example, different levels of product variety compared with competitors can result in different strategies, such as different degrees of focus on either cost leadership, differentiation or hybrid strategies. Product customisation is a factor which increases product variety (Silveria, 1998) that can have a negative impact on cost leadership (Um *et al.*, 2017). A high product variety environment typically has unpredictable demand, short life cycle, close customer relationship and high margin (Fisher *et al.* 1977; Stavroulaki and Davis, 2010). Thus, focus should be on SC agility, differentiation and customer service (Um, 2017). Instead, a low product variety environment has more predictable demand, close supplier relationship and mass production (e.g. economy of scale) focusing on SC cost efficiency and cost leadership.

Cost leadership is related to cost reduction as a market winner, and differentiation is related to new product development or variety increase with high quality (Kim, 2006). Hallgren and Olhager (2009) insisted that the three strategies of Porter (2004) can fundamentally be reduced to two, since the company must choose between cost leadership and differentiation strategies even with a focused strategy. In this study, cost leadership has two elements: low price and low manufacturing unit cost. Differentiation has three



components that are related to customer service (i.e. product), technology, and marketing differentiation respectively. For example, deliver a high quality product with volume flexibility, develop a new product quickly with design flexibility, and control the sales and distribution network with a distinctive brand image (see Kim. 2006; Hallgren and Olhager. 2009). Capabilities such as agility and cost efficiency contribute positively to business performance, either acting alone or in concert with other capabilities (Rosenzweig *et al.*. 2003). The variety-related characteristics in SC are summarised in Table 1.

**Table 1. General characteristics of product variety in supply chain**

Hypotheses 1-1 to 1-2 were designed to investigate strategic differences and performance according to the level of product variety. In terms of alignment of product variety with the strategies, the research considered SC agility, SC cost efficiency, differentiation, cost leadership and business performance. The performance of a SC can be attributed to a match or mismatch between the type of product (i.e. innovative or functional) and the design of the SC (Fisher, 1977). Stavroulaki and Davis (2010) also highlighted alignment between the key aspects of a product including product variety, and its SC processes and strategy. From the perspective of variety, a high level of product variety corresponding with a high level of customisation typically focuses on differentiation, variety management strategies and customer relationships that enhance SC agility, while a low level of product variety corresponding with a low level of customisation generally focuses on cost leadership and cost efficiency. Also, based on the long-tail effect, the change in the consumption pattern when more niche products are being provided enables demand to shift from the hits to the niches over time, which can improve customer service and satisfaction (Anderson, 2006; Zhou and Duan, 2012). Thus, the study

proposes the strategic alignment matching strategies with product variety and the SC, shown in Figure 1 (the strategic alignment model) and the following hypotheses:

***Hypothesis 1-1:*** *High product variety is associated with increased focus on differentiation.*

***Hypothesis 1-2:*** *Supply chain agility is associated with increased focus on differentiation.*

### **Figure 1. Strategic alignment model with product variety in SC**

Cost efficiency is dominant for mass production systems with a low level of customisation and variety, while more enhanced customer service is required for companies where product variety matters (see Agarwal *et al.*, 2006). Therefore, business strategies should be considered in line with the level of product variety and SC strategies. According to Silveira (1998), the most significant factors motivating an increase in product variety are the ability to customise the product and the demands made by customers. In short, product proliferation and variety increase together (Hu *et al.*, 2011). Under this circumstance an agile system is appropriate for differentiation that focuses on product variety and customisation and is negatively associated with a cost-leadership strategy that focuses on cost efficiency (Hallgren and Olhager, 2009). Thus the study proposes the following two hypotheses:

***Hypothesis 2-1:*** *Low product variety is associated with increased focus on cost leadership.*

***Hypothesis 2-2:*** *Cost efficiency is associated with increased focus on cost leadership.*

Business performance is measured through accounting data that represents the company's performance and market valuation (Vickery *et al.*, 2003) such as return on

assets (ROA), return on investment (ROI) and return on sales (ROS). Tan *et al.* (1999) recommended nine diverse measures of business performance that involve market share, ROA and overall competitive position (market share growth, sales growth, ROA growth, production cost, customer service levels, product quality and competitive position). Vickery *et al.* (1999) supported the use of ROI, ROS, market share and the performance growth of each (e.g. market share growth) for business performance. Panayides (2007) argued that multiple measures of performance would reflect a firm's improvements more accurately. Thus, this study employed ROI, ROS, market share growth and sales growth to indicate business performance.

Product variety incurs cost increase in SC mainly due to the increased complexity in manufacturing, purchasing and logistics functions in SC. Also, trade-off exists between product variety and SC performance while a relationship between product variety and business performance is still arguable. Kekre and Srinivasan (1990) investigated the market benefits and cost disadvantages of product variety and concluded that product variety increases market share and a firm's profitability. To improve profitability, firms should make competitive moves, and new product introductions (NPI) are one of these moves that might positively influence market share and returns (Otero-Neira *et al.*, 2010). However, in the case of mature firms, increased variety may not increase total demand that improves profitability. Instead, firms can increase variety to retain market share by a differentiation approach. Besides cost increases, an extensive array of options can at first seem highly appealing to consumers, yet can reduce their motivation to purchase the product. To address this variety issue, appropriate strategic approaches are crucial to achieve better business performance. Thus, the study proposes the following hypotheses based on the structural equation model (Figure 2):

**Hypothesis 3:** *Differentiation and cost efficiency are associated with business performance.*

**Hypothesis 4:** *Differentiation and cost leadership mediate the relationship between product variety and better business performance.*

Different location and country characteristics affect the overall performance of a firm differently, and the level of internationalisation of each country may impact on economic performance (Antonio *et al.*, 2012). As well as to confirm the findings, the study applies a comparative analysis to the cases of the UK and Korea, considering the different strategic focus of companies in each country and business performance measured according to the level of product variety.

### **Figure 2. Structural equation model**

### **3. Research methodology**

A questionnaire considering the product variety issues was sent to companies identified as manufacturers, based on their standard industrial classification (SIC) code. The data was collected from two countries with the intention of conducting a cross-examination and comparison. The survey was conducted by post with a package including a covering letter and return stamped envelope for the UK companies. In Korea, in order to obtain an acceptable level of response, email and direct interview surveys were chosen. 212 companies responded to the survey from the UK and 152 from Korea (total = 364), yielding an acceptable 18% overall response rate (see Frohlich 2002; Anseel *et al.*, 2010). As a whole, 84.1% of the participants had positions above assistant manager and sales representative. 59.1% of the firms were small or medium-sized (SMEs) and the remaining

40.9% were large firms (LEs). Table 2 presents the industry types of the survey respondents. The demographic analysis of the responses indicated that the participating firms spanned a diverse group of manufacturing industries, which allowed for generalisation of the findings (Gatignon and Xuereb, 1997). Product variety was measured as fundamental, intermediate and peripheral using a 5-point scale (1= 1-5, 2= 6-10, 3= 11-15, 4= 16-20, 5= above 20) based on the core product family (MacDuffie *et al.*, 1996). Also, strategies including differentiation, cost leadership, cost efficiency, SC agility and business performance were measured using a 5-point Likert scale (1= poor, 5= excellent). Questions of cost leadership, differentiation and business performance compared to the company's competitors were asked.

### **Table 2. Industry analysis**

The study sample was examined to determine whether non-respondent manufacturers differed significantly from those responding regarding key characteristics (i.e. sales and number of employees), as suggested by Armstrong and Overton (1977), Gerbing and Anderson (1988) and Wiengarten *et al.* (2012) to check the existence of non-response bias. The result revealed that the sample did not suggest the presence of non-response bias. In addition, a measurement invariance test was applied since samples were taken randomly from the UK and South Korea, to identify the critical assumption that the basic structure of the model is stable across cultures, and that individuals in different countries use its scale in a similar manner (Turker, 2009; Malham and Saucier, 2014). Thus, through multi-group confirmatory factor analyses (CFA) the results of fit indexes suggest that measurement invariance is supported across the two countries ( $\chi^2/df = 2.09$ , RMSEA = 0.054, SRMR = 0.606, CIF = 0.903). For common method bias, Harman's one-factor test was conducted

using all variables. Since no single factor was apparent in the un-rotated factor structure, common method variance does not exist.

## **4. Results**

### *4.1 Reliability and validity*

Both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted using AMOS 22 to examine reliability and validity since items were collected from different studies. First, all constructs were assessed with CFA and the measurement model offered a satisfactory fit ( $\chi^2_{[213]} = 347.507$ , GFI = 0.925, SRMR = 0.037, RMSEA = 0.042, CFI = 0.965) with acceptable factor loadings ( $>0.59$ ). Composite reliability (CR) also presented internal consistency (CR  $> 0.754$ ). Convergent validity was confirmed as all factor loadings exceeded 0.5, as well as acceptable average variance extracted (AVE  $> 0.506$ ). Table 3 indicates the result of CFA indicators. In addition, there is no case where the square of the correlation between a pair of constructs is greater than the AVE of the constructs. Thus, discriminant validity using the procedures suggested by Fornell and Larcker (1981) was confirmed (see Table 4).

**Table 3. Confirmatory factor analysis**

**Table 4. Inter-construct correlation estimates and related AVEs**

Second, Cronbach's alpha was tested to measure the reliability of the scale items before the EFA. The results yielded acceptable alpha values (Nunnally, 1978) and six structures showed acceptable internal consistency ( $>0.795$ ). EFA was then applied to check construct validity (McDonald, 1981; Hattie, 1985). Six factors were extracted with eigenvalues greater than 1, and six structures explained 68.0% of the total variance and all of the

loadings above the minimum cut-off, 0.5 (Hair *et al.*, 2010). EFA results showed all items with a high within-factor loading (i.e. convergent validity) and a low cross-factor loading (i.e. discriminant validity). The results of separate EFAs for both the UK and Korea also showed acceptable reliability and validity with the same items loaded. Thus, the variables of the construct have a consistent and stable structure across the groups (Floyd and Widaman, 1995). EFA and CFA confirmed the stability of all constructs for SEM and t-test. Table 5 presents the EFA pattern matrix.

### **Table 5. Exploratory factor analysis**

#### *4.2 Structural equation modelling*

To test our proposed theoretical and empirical model, structural equation modelling (SEM) analysis was conducted. The result from samples shows that increased product variety and SC agility improve differentiation, while a decrease in product variety and an increase in cost efficiency improve cost leadership; thus hypotheses 1 (1-1 & 1-2) and 2 (2-1 & 2-2) are accepted. Also, business performance is associated with cost leadership and differentiation that mediates the relationship between product variety and business performance. Therefore, hypotheses 3 and 4 are accepted. Table 6 indicates the results of the structural equation modelling. Both high product variety and SC agility have a significant impact on the differentiation at 0.001 and 0.01 levels respectively. In addition, low product variety and cost efficiency are significantly related to cost leadership at 0.05 and 0.001 levels respectively. Product variety did not impact directly on business performance ( $p = 0.557$ ); instead, cost leadership and differentiation mediate the relationships at 0.05 and 0.001 levels respectively.

## **Table 6. Results of Structural Equation Modelling**

### *4.3 Comparison between UK and Korea*

To test the research findings through a cross-examination a t-test was conducted. Regarding business strategies, cost leadership ( $p < 0.01$ ) and differentiation ( $p < 0.1$ ) varied significantly between the two countries. In the case of performance measures, SC agility ( $p < 0.001$ ), SC cost efficiency ( $p < 0.01$ ) and business performance ( $p < 0.05$ ) showed significant differences. With regard to mean value, the UK (mean = 3.51) exhibited a sharper focus on differentiation than Korea (mean = 3.36), while Korea (mean = 3.42) focused more on cost leadership than the UK (mean = 3.18). In addition, Korea scored better on cost efficiency than the UK. However, Korea (mean = 3.39) exhibited superior SC agility to the UK (mean = 3.11). Lastly, the UK (mean = 3.70) had better business performance than Korea (mean = 3.52). The results imply that the UK focuses on a higher level of product variety and differentiation strategy (see Stavroulaki and Davis, 2010), which leads to superior business performance compared with Korea. Korea focuses more on cost leadership with lower-level product variety, which leads to higher cost efficiency. Table 7 explains the comparison of t-tests between the two countries.

### **Table 7. T-test of structures by country**

## **5. Discussion**

The study demonstrated the alignment of business strategy between product variety and SC through SEM analysis. The test justifies the appropriate business strategy according to companies' level of product variety and matching SC focus. A high product-variety policy is matched with agile SC as a differentiation strategy, while a low product-variety policy



matches lean SC as a cost leadership strategy. High product variety with efficient SC can follow a 'mass customisation' strategy (e.g. automobile and computer industries such as BMW and Dell) while low product variety with an agile SC can be regarded as a 'hybrid' strategy (e.g. perishable food and electronic components industries such as Aldi and Intel). Therefore, the survey results support the concept that companies employing differentiation strategies by providing different product variety focus more on SC agility, customer service and relationship, which results in a high margin. Companies employing a cost leadership strategy with low product variety ensure SC efficiency through economy of scale, which leads to cost reduction.

However, product variety does not always guarantee improved business performance ( $p = 0.557$ ). Given the cost burden from the provision of product variety, companies should link their strategic alignment and capabilities with either SC agility or cost efficiency. Thus, decisions on differentiation, cost leadership or hybrid strategies can be considered based on the existing level of product variety and/or intention of new product introduction as well as SC capability supported. Especially business strategies such as differentiation and cost leadership significantly mediate the relationship between product variety and business performance. Any mismatched alignment cannot achieve the better business performance. The perception that product variety has the potential to positively influence market share and returns (Otero-Neira *et al.*, 2010) is supported only through appropriate and matching business strategies (i.e. mediating factor). The results also support that an agile system is matched with differentiation, while cost efficiency is matched with a cost-leadership strategy (Hallgren and Olhager, 2009). At the functional level, the cost burden can be minimised by use of advanced technologies and appropriate strategies such as modularity, cellular manufacturing, information technology, postponement and SC integration strategies.

The study extends the concept to the national level to justify the implications of the research findings. The UK shows higher levels of variety, differentiation and business performance while Korea exhibits higher performance in cost efficiency, cost leadership and SC agility, as supported by Stavroulaki and Davis (2010) and Agarwal *et al.* (2013). Higher levels of the production-dominant variety (i.e. increased production cost outweighs increased market mediation cost) are positively related with high-volume production (Randall and Ulrich, 2001). Thus, Korea appears to focus more on scale-efficient production (e.g. production-dominant variety) with a lower level of product variety than the UK, which has unstable demand due to greater product variety. However, it is notable that Korea has higher SC agility performance than the UK, which runs counter to the expectation that the higher the level of product variety the higher the level of agility. One explanation is Korea's high dependence on exports and manufacturing-based industry, as supported by Antonio *et al.*'s (2012) research. Supply chain activities for a quick response (i.e. agility) as a form of distinctive competence enable firms to achieve competitive export advantages (Piercy *et al.*, 1998). Also, SC agility is a critical factor affecting overall global competitiveness (Swafford *et al.*, 2006), especially for an export-based country. Christopher *et al.* (2006) concluded that agility and responsiveness are increasingly fundamental to competitive success in global business activity, such as global sourcing, offshore manufacturing and export. Thus, a global SC should be sufficiently agile to allow firms to improve their business performance and manage demand and supply uncertainty by being more responsive to unexpected change. Thus, a country concentrating on export competitiveness must achieve a global SC network structure with a high level of agility. For example, the total annual volume of exports in Korea (US\$ 527 billion) is lower than for the UK (US\$ 674 billion); however, export dependability accounted for a higher

percentage of the GDP in Korea (36%) as compared to the UK (23%) in 2015 (International Monetary Fund, 2016; Central Intelligence Agency, 2016).

At the organisational level, the proximity of production facilities to the target market also enhances SC agility (Lee, 2004). Thus, companies that have a high level of product variety require careful consideration of their focus on local production and distribution to improve SC agility as well as variety management strategies such as modularity and postponement for cost reduction. In addition, better logistics performance can boost SC agility (see Arivis *et al.*, 2012). Nowadays, the dominant trend in manufacturing industry is not towards pure customisation or pure standardisation, but towards the middle position of customer involvement (Lampel and Mintzberg, 1996), which is mass customisation. Thus, manufacturers that provide a low level of product variety may consider a structural shift to mass customisation in order to benefit from their SC agility capability. However, the movement should match the SC strategy and be supported by variety management activities.

## **6. Conclusions**

The study investigated the relationships between product variety, SC and business strategies to improve business performance. First, the study demonstrated the importance of strategic alignment between product variety and SC focus, and suggested a theoretical justification for the choice of business strategies through the proposed model. A high level of product variety matches agile SC, while low product variety is aligned with SC cost efficiency. However, the level of product variety improves business performance only through matching business strategies such as cost leadership and differentiation. Therefore, an appropriate business strategy, considering the level of product variety and matching SC strategy, achieves the better business performance. Second, the overall comparison

between the two countries found manufacturers in the UK demonstrating higher levels of product variety and differentiation (see Stavrulaki and Davis, 2010; Agarwal *et al.*, 2013) than manufacturers in Korea. Instead, Korea displayed higher cost leadership attributes and cost efficiency than the UK. However, Korea shows better agile SC performance than the UK, which indicates the potential to increase product variety without incurring a significant cost burden.

This research makes several contributions. For theoretical implications, confirmative and exploratory factor analyses formed the concepts of each structure. Then, structural equation modelling confirmed the strategic relations between product variety and SC focus to improve business performance. Also, the comparison between manufacturers in the UK and Korea supports the fact that a high product-variety context focuses more on differentiation while a low product-variety context focuses on cost efficiency and cost leadership (Stavrulaki and Davis, 2010; Agarwal *et al.*, 2013). Regarding practical contributions, the findings suggest manufacturers appropriate SC strategies based on the existing level of product variety in order to achieve competitive advantage. Such insight is particularly valuable for manufacturing concerns that are considering changing the heterogeneity of their product base through increased product variety for better business performance.

There are several limitations associated with this research. First, it investigated exclusively manufacturing industries in the UK and Korea. This particularity may limit the generalisability of the findings to other populations with different competitive, environmental, economic and cultural characteristics (Hughes and Morgan, 2008; Antonio *et al.*, 2012). In addition, the growth and development of SCs is not driven only by internal motives, but also by a number of external factors, such as increasing globalisation, reduced barriers to international trade, advances in information technology, environmental

concerns and government regulations (Gunasekaran *et al.*, 2004). An appropriate topic for future research concerns the practical approach for multinational corporations to cope with variety and global SC issues without sacrificing costs.

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**Table 1. Characteristics of product variety in supply chain**

Product Variety	Low	High
Demand Uncertainty	Predictable	Unpredictable
Production Focus	Economy of scale	Diseconomy of scale
Level of customisation	Low customisation	High customisation
Production structure	Make to stock	Make / assembly to order
Product life cycle	Long	Short
Product type	Functional	Innovative
Relationship focus	Suppliers	Customers
Supply chain strategy	Lean SC	Agile SC
Market strategy	Cost leadership	Differentiation
Supply chain focus	Cost	Customer service
Profit margin	Low	High

Source: Adapted from Fisher et al. (1977), Stavroulaki and Davis (2010)

**Table 2. Industry analysis**

Characteristics	UK		Korea	
	Frequency	Percentage	Frequency	Percentage
<b><i>Manufacturing industry type</i></b>				
Food, beverage, tobacco	17	8.0	9	5.9
Wood and furniture	21	9.9	11	7.2
Chemical materials and products	15	7.1	13	8.6
Non-metal mineral products	10	4.7	5	3.3
Fabricated metal products	29	13.7	4	2.6
Computer and communication products	9	4.2	17	11.2
Electronic parts and components	19	9.0	22	14.5
Electrical machinery and equipment	18	8.5	21	13.8
Transport equipment	23	10.8	15	9.9
Textiles and leather	5	2.4	3	2.0
Paper products	3	1.4	8	5.3
Machinery and equipment	23	10.8	10	6.6
Basic metal products	5	2.4	3	2.0
Clothing and footwear	5	2.4	6	3.9
Other	10	4.7	5	3.3
Total	212		152	

**Table 3. Confirmatory factor analysis**

Structure	Code	Abbreviated item statement	Factor loading	CR	AVE
Product Variety	P1	Different core models and designs	0.789	0.754	0.506
	P2	Different technical options dependent on core design	0.862		
	P3	Particular options and accessories independent of core design	0.837		
Supply chain agility (AG)	AG1	Ability to rapidly reduce product development cycle time	0.674	0.870	0.570
	AG2	Ability to rapidly reduce lead time	0.740		
	AG3	Ability to rapidly increase the level of product customization	0.720		
	AG4	Ability to rapidly improve level of customer service	0.727		
	AG5	Ability to rapidly improve delivery reliability	0.761		
	AG6	Ability to rapidly improve responsiveness to changing market needs	0.763		
SC Cost efficiency (CE)	AG7	Ability to rapidly reduce delivery lead time	0.758	0.865	0.617
	CE1	Ability to minimize total cost of resources used	0.760		
	CE2	Ability to minimize total cost of distribution (including transportation and handling costs)	0.716		

	CE3	Ability to minimize total cost of manufacturing (including labour, maintenance, and re-work costs)	0.714		
	CE4	Ability to minimize total inventory holding costs	0.626		
Cost leadership	CL1	Reduce manufacturing unit cost	0.866	0.913	0.760
	CL2	Supply low product price	0.780		
Differentiation	D1	Customer service differentiation (deliver a high quality product with volume flexibility and agility)	0.767		
	D2	Technology differentiation (develop a new product quickly with design flexibility depending on demand)	0.769	0.835	0.630
	D3	Marketing differentiation (control the sales and distribution network with a distinctive brand image)	0.586		
Business Performance	BP1	Return on sales	0.590		
	BP2	Return on assets	0.632	0.873	0.637
	BP3	Market share growth	0.790		
	BP4	Sales growth	0.854		

Composite Reliability (CR) =  $(\sum \text{standardized loading})^2 / \{(\sum \text{standardized loading})^2 + \sum \epsilon_i\}$

Average variance extracted (AVE) =  $\sum (\text{standardized loading})^2 / (\sum (\text{standardized loading})^2 + \sum \epsilon_i)$

Note: Fit indices:  $\chi^2/df$  (chi square) = 347.507 / 213 = 1.63, GFI (goodness of fit index) = 0.925, SRMR (standardized root mean square residual) = 0.037, RMSEA (root mean squared error of approximation) = 0.042, CFI (comparative fit index) = 0.965

**Table 4. Inter-construct correlation estimates and related AVEs**

	PV	AG	CE	CL	D	BP
PV	0.506 <sup>+</sup>					
AG	.155**	0.570 <sup>+</sup>				
CE	.056	.386**	0.617 <sup>+</sup>			
CL	-.062	.292**	.499**	0.760 <sup>+</sup>		
D	.231**	.531**	.385**	.282**	0.630 <sup>+</sup>	
BP	.140**	.298**	.415**	.211**	.419**	0.637 <sup>+</sup>
Mean	3.44	3.23	3.40	3.28	3.45	3.63
SD	1.31	0.74	0.62	0.75	0.73	0.65

+ =Average variance extracted, \* represents significant at the 0.05 level and \*\* 0.01 level.

**Table 5. Exploratory factor analysis**

Items	1	2	3	4	5	6
	$\alpha=0.806$	$\alpha=0.835$	$\alpha=0.795$	$\alpha=0.868$	$\alpha=0.835$	$\alpha=0.835$
AG1	.755	.065	.063	.046	.076	.129
AG2	.776	.067	.168	.016	.102	.156
AG3	.760	.028	.037	.130	.168	.031
AG4	.708	.156	.111	.059	.178	.002
AG5	.758	.111	.120	-.056	.149	.065
AG6	.753	.103	.188	.084	.152	-.081
AG7	.767	.072	.142	.037	.061	.123
BP 1	.118	.744	.197	-.052	.218	.014
BP 2	.069	.811	.170	-.083	.158	-.011
BP 3	.124	.764	.100	.168	.087	.124
BP 4	.143	.811	.147	.165	.014	.044
CE1	.176	.128	.762	.014	.035	.220
CE2	.175	.181	.705	.016	.072	.198
CE3	.138	.118	.787	.038	.128	.076
CE4	.136	.182	.685	-.015	.138	.085
PV1	.057	.090	.052	.862	.085	-.033
PV2	.049	.053	-.019	.895	.066	-.008
PV3	.103	.017	.004	.872	.084	-.061
D 1	.283	.195	.102	.129	.750	.099
D 2	.389	.223	.142	.104	.630	.045
D 3	.172	.102	.147	.076	.763	.086
CL 1	.129	.063	.321	-.079	.105	.816
CL 2	.154	.077	.226	-.041	.099	.865

**Table 6. Results of structural equation modelling**

Construct	Path coefficient	t-value	Significance
1. Differentiation			
SC Agility	+ .530***	8.086	.000
Product Variety	+ .076**	3.238	.001
2. Cost Leadership			
SC Cost Efficiency	+ .765***	9.749	.000
Product Variety	- .065*	- 2.234	.025
3. Business Performance			
Differentiation	+ .527***	5.826	.000
Product Variety	+ .016	.558	.557
Cost Leadership	+ .133*	2.373	.018

$\chi^2_{(221)} = 182.119$ ; GFI = 0.898; CFI = 0.932; NNFI = 0.922; RMAEA = 0.057; SRMR = 0.065

\* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001

**Table 7. T-test of structures by country**

Dependent Variable	Mean				Significance
	UK	Korea	Total	T	
Product variety	3.74	3.04	3.44	5.195***	.000
SC Agility	3.11	3.39	3.23	-3.581***	.000
SC Cost efficiency	3.31	3.52	3.40	-2.963**	.003
Cost leadership	3.18	3.42	3.28	-3.156**	.002
Differentiation	3.51	3.36	3.45	1.858 <sup>+</sup>	.064
Business performance	3.70	3.52	3.63	2.591*	.010

<sup>+</sup> represents significant level p < 0.1, \* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001

**Figure 1. Strategic alignment model with product variety in SC**

	Low Product Variety	High Product Variety
SC Efficiency	Cost Leadership	Mismatch
SC Agility	Mismatch	Differentiation

**Figure 2. Structural equation model**

