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Supplier Quality Management and Performance: The Effect of Supply Chain Oriented Culture

Drawing from contingency theory, we investigate the impact of Supplier Quality Management (SQM) activities on internal quality performance and (ii) examine the role of Supply Chain Oriented (SCO) culture in the relationship between SQM and internal quality performance. A survey-based research was designed to collect data from 518 UK manufacturing firms. The results indicate that organisations with strong SCO culture are more conducive to increased levels of trust, commitment, cooperative norms, organisational compatibility and managerial support. As such, effective supplier development and integration activities appear to bring about a higher level of internal quality performance. The results also support the moderating effect of SCO culture on the relationship between supplier quality management and internal quality performance. The study highlights the importance of SCO culture - if organisations want to optimise internal quality and organisational performance in a sustainable manner through effective buyer-supplier relationships. This study contributes to the literature by analysing SQM and internal quality performance relationships through the lens of contingency theory and presents empirical evidence in support of the context dependency nature of SQM and its impact on performance. In this respect, a contextual variable theorised as 'SCO culture' is conceptualised to understand the SQM - performance relationship.

Keywords: Supply chain management, quality management, supply chain oriented culture, supplier involvement, supplier integration.

Article Classification: Research paper

1. Introduction

Supplier Quality Management (SQM) is regarded as a key ingredient that is imperative for improving internal quality performance (Zsidisin et al., 2016; Lee and Li 2018). It is defined as a collection of management activities which are necessary ingredients for enhancing the quality performance of an organisation through the blending of supplier activities with the buyer activities and simultaneous engagement and communication

between the two parties (see Chakravarty, 2014, 103-4). In the supply chain literature, SQM has been operationalised through three dimensions, namely, supplier selection, supplier development, and supplier integration (Lo and Yeung, 2006). Although extensive research has focused on supplier selection (see Pedraza-Acosta, Pilkington and Barnes 2016; Awasthi, Govindan and Gold 2017; Cole and Aitken 2019) and supplier development (see Salimian, Rashidirad and Soltani 2017; Zhang, Pawar and Bhardwaj 2017; Quigley et al. 2018), it is only relatively recently that supplier integration has received significant attention (e.g., Mandal and Jha 2018; Zhang et al. 2018)—owing to the fact that integration of suppliers early in the development and manufacturing phases could substantially impact on internal quality performance of a firm (see Gimenez et al. 2012; Duhaylongsod and Giovanni 2019). For example, supplier integration has been examined both theoretically and empirically from different perspectives ranging from downstream, supplier-customer (Dalvi and Kant 2018) to upstream, supplier-supplier integration (Das, Narasimhan and Talluri 2006). In addition, it is suggested that for the recognised transition of Supply Chain Management to collaborative practice such as goal-oriented networks, supplier integration is central to progressive and competitive practice (Stevens and Johnson 2016).

Despite the acknowledged significance of effective SQM practices and their (in)direct positive impact on organisational performance (e.g., Nair, Jayaram and Das 2015; Zhang et al. 2018; Ali 2020), there is a disagreement among scholars as to the (in)direct relationship between SQM and internal quality performance. While some scholars (e.g., Curkovic, Vickery and Drog 2000; Shin, Collier and Wilson 2000; Lo, Sculli and Yeung 2006; Soares et al. 2017) attempt to make direct positive connections between SQM and quality performance, others (e.g., Jayaram et al. 2012; Parvadavardini, Vivek and Devadasan 2016; Salimian, Rashidirad and Soltani 2017) advocate a

contingent view of SQM and internal quality performance. The roots of this inconsistency are two-fold. First is the absence of comprehensive research with a specific focus on the relationship between different dimensions of SQM and internal/external quality performance dimensions. Investigating all three dimensions of SQM in a single study and their impact on internal quality performance will make the first major theoretical contribution of this research. Second is insufficient attention to the context dependency of SQM. To date, studies of the impact of SQM on quality performance have generally analysed SQM as a universal concept. In other words, the moderating influence of contextual factors on the multidimensional relationship between SQM and quality performance has been underestimated. In particular, a review of the literature indicates that the intricacies of Supply Chain Oriented (SCO) culture and quality performance have remained comparatively understudied (see Zhang, Linderman and Schroeder 2012; Schulze-Ehlers et al. 2014). Given the potential effect of contextual SCO Culture factors on SQM, it is somewhat surprising to find that little empirical research (e.g., Salimian, Rashidirad and Soltani 2017; Han, Huang and Macbeth 2018) has explicitly focused on exploring and describing this issue (Mello and Stank 2005). Due to the lack of a fundamental theoretical framework to depict the contextual nature of this research (see McAdam, Miller and McSorley 2019), this research applies contingency theory to explore how SCO culture can be influential in yielding internal quality performance.

This study is designed to offer a response to such void and imbalance in the literature by investigating the effect of SCO culture on the relationship between SQM and quality performance (see Schulze-Ehlers et al. 2014). This study contributes to literature and practice in a number of ways. Whilst previous research had a tendency to overemphasise quality performance from an external perspective (e.g., Das, Handfield and Ghosh 2000), we lay stress on internal quality performance – owing to the fact that

any improvement in internal quality performance, in an integrated supply chain should impact and extend to the entire supply chain performance (e.g., Fynes, Voss and De Burca 2005). This is one of the very few studies that makes an attempt to explore the relationship between SQM and internal quality performance as multi-dimensional (rather than unidimensional) constructs. To do so, internal quality performance is studied through the two dimensions of design quality and conformance quality. Design quality is defined as a collection of quality characteristics that are designed to increase the usability of a product (Salimian, Rashidirad and Soltani 2017). Conformance quality connotes the degree of fit between the characteristics of a product and its actual attributes (Fynes, Voss and De Burca 2005). The multi-dimensional consideration of SQM and internal quality performance not only assists us to clarify inconsistencies in existing literature, but also highlights the significance of a holistic understanding of the relationships between the research constructs (see Sousa and Voss 2008). Furthermore, we employ contingency theory to explain the contextual nature of SQM performance effect on internal quality performance. In contrast to previous research that has explored the performance impact of organisational culture on SQM (e.g., Cao et al. 2015), the current study uses SCO culture (in the form of five dimensions: trust, commitment, cooperative norms, organisational compatibility and top manager support - see Mentzer et al. 2001). Prior studies in supply chain has rarely considered the supply chain cultural effects on design and conformance quality. We analyse the impact of SQM practices in light of the moderating effects of SCO culture on quality performance. In this respect, our research heeds the suggestion offered by Koster and Shinohara (2004, 15) that ‘given the rapid globalisation of markets, cultural differences in the supply chain will present even greater challenges in the future’.

More specifically, the following research questions guide our study: (1) To what extent is the relationship between SQM and internal quality performance significant? And (2) to what extent does the contingency factor of SCO culture moderate the relationship between SQM and internal quality performance? To answer these research questions a survey was undertaken involving 518 manufacturing organisations across a sample of four UK-based industries operating in electronics, plastics, chemical and precision sectors. The findings of this study assist the managerial decision making processes to support SQM as a contingent managerial effort, which has a great impact on organisational performance. It suggests managers and practitioners to adopt a holistic supply chain perspective, rather than an isolated organisational perspective, and create an operating environment in which their organisations integrate their suppliers' capabilities into their operational processes to maintain their sustainability.

2. Background and research hypotheses

2.1 The role of SQM dimensions on internal quality performance

Supplier selection is conceptualised as a collection of activities which assists an organisation to select the best suppliers (Yoon et al. 2018). The significance of this dimension of SQM arises from the premise that reducing production costs and enhancing the quality of products are not truly possible without reliable suppliers (Sawik 2018). The main criteria in the process of supplier selection are quality, cost, delivery performance and the ability of suppliers to participate in the design and production processes of an organisation (Araz and Ozkarahan 2007).

The growing recognition of the importance of suppliers indicates that suppliers should be selected based on their ability to meet the organisational requirements of new product development as well as design and manufacturing (Chen, Wang and Tan 2019). Gonz, Quesada and Mora (2004) and Ahmed and Modal (2019) argue in favour of the

positive influence of supplier selection on the quality of finished goods, and refer to supplier selection as the most important contributor to the quality of products. Lo, Sculli and Yeung (2006) take the argument further by stating that organisational quality performance is highly influenced by the performance of its suppliers. Kannan and Tan (2002) refer to commitment to quality, technical expertise and suppliers' willingness to share confidential information as some of the criteria to select appropriate suppliers. Suppliers which are selected based on these criteria are expected to make a significant contribution to the processes of design and manufacturing of new products. As a result, design quality and conformance quality of the buying organisation should be improved due to the contribution of its selected suppliers. Thus, it is proposed that:

H1. *Supplier selection is positively associated with (a) design quality, and (b) conformance quality.*

Supplier development is defined as the cooperation between a buying organisation and its suppliers to improve the suppliers' performance continuously (Glavee-Geo 2019). Supplier development has been conceptualised within a broad band of operations and supply chain concepts and consequently, it has been interpreted from different perspectives (Quigley et al. 2018). In this respect, supplier development could involve various activities ranging from education and training programmes offered to suppliers and supplier evaluation (Jin, et al. 2019), to providing suppliers with capital investment (Arroyo-Lopez, Holmen and Boer 2012; Lee and Li 2018). Improving quality performance has been addressed as one of the main outcomes of supplier development strategies (Modi and Mabert 2007).

The influence of supplier development on internal quality performance can be postulated through various supplier development activities. First, some scholars posit that supplier training increases the skills level of suppliers' employees and therefore, enhances

the suppliers' performance (e.g. Wagner and Krause 2009). Second, supplier development through investing in suppliers' operations to further increase their abilities to meet organisational needs can directly enhance suppliers' performance (Glavee-Geo 2019). Third, formal and informal assessment of suppliers' performance may enhance the quality of products in a suppliers' site (Lee and Li 2018). All these activities lead to achieving a higher quality of raw materials that assists a buying organisation to increase the quality of design and manufacturing of its finished products. In fact, high quality raw materials aid an organisation to design better products, and this has the potential to directly affect the quality of end products. Altogether, better design abilities and product improvement of suppliers have been frequently cited as some of the outcomes of supplier development activities (e.g., Lawson, Krause and Potter 2015; Lee, Chan and Pu 2018).

Dey et al. (2015) among others, have argued that supplier development has a direct effect on organisational performance. In respect of quality performance outcome, the significant role of supplier's quality management programmes in the quality of finished products has been addressed in the literature (e.g. Parmigiani and Mitchell 2010). For example, training suppliers' personnel and investing in suppliers' operations and quality assessment could enhance suppliers' abilities to participate in organisations' design and manufacturing processes. As a result of these activities, design quality and conformance quality of the organisations are expected to be improved. Therefore, it can be hypothesised that:

H2. *Supplier development is positively associated with (a) design quality, and (b) conformance quality*

Supplier integration refers to a set of activities that result in close coordination and collaborative relationships between buyers/manufacturers and their tiers of suppliers through shared management information systems (see Omar et al. 2012a; Zhang et al.

2018). Sharing knowledge and technology with suppliers (e.g., Bennett and Klug 2012), supplier involvement in product design and development activities (e.g., Jayaram 2008; Duhaylongsod and Giovanni 2019) and joint problem identification and prevention (e.g., Das, Narasimhan and Talluri 2006) have been frequently cited as the three main aspects of supplier integration.

According to Schulze-Ehlers et al. (2014), continuous logistics of high quality products may not be accessible, if there is no effective cooperation between an organisation and its suppliers. In fact, the positive contribution of supplier integration to product quality has been acknowledged in the extant literature (e.g., Kulp, Lee and Ofek 2004). As Wagner (2003) points out, development is one of the main phases of supplier integration. During this phase, integration exists between an organisation and its suppliers to design product specifications. There is a considerable body of research (e.g. Ye, et al. 2018), which places emphasis on the integration to suppliers during the design process as a means to enhance the quality of products. For instance, Rosenzweig, Roth and Dean (2003) postulate the positive contribution of supplier integration to the design quality of products through lowering the misunderstanding of products' specifications between an organisation's design engineers and its suppliers. They further argue that supplier-buyer collaboration could enhance manufacturability of products. Since design for manufacturability is one of the variables for measuring design quality (Anderson 2014), it can be argued that supplier integration serves as a positive contributor to design quality of products.

The extant literature (e.g., Zhao, Cavusgil and Cavusgil 2014) reveals a variety of supplier integration benefits in new product development. For example, Perols, Zimmermann and Kortmann (2013) refer to rework, which can be removed through increasing the accessibility of product parts due to a high level of integration between an

organisation and its suppliers. As rework is one of the variables to measure conformance quality (Phan, Abdallah and Matsui 2011), it can be argued that supplier integration can positively impact on conformance quality. Thus, the following is suggested:

H3. *Supplier integration is positively associated with (a) design quality, and (b) conformance quality.*

2.2 The moderating role of SCO culture

The underlying theory which enables us to elaborate the moderating impact of SCO culture on the link between SQM dimensions and internal quality performance is contingency theory. This theory is firstly discussed to build the foundation for the next three research hypotheses.

Contingency theory suggests that ‘organisational effectiveness results from fitting characteristics of the organisation ... to contingencies that reflect the situation of the organisation’ (Donaldson 2001, 1). This theory is mainly applied where there is no fundamental theoretical framework to depict contextual nature of the research (De Clercq, Thongpapanl and Dimov 2014; McAdam, Miller and McSorley 2019) highlighting the fact that there is no single or universal approach to management (Jayaram, Ahire and Dreyfus 2010). According to Srinivasan and Bryan (2014), this contextual approach to the studies of quality management is much more effective than the best practice and rule based approaches. Thus, adopting this theory will enable us to focus on the pragmatic aspects of a research phenomena (see Corley and Gioia 2011), which in this paper is the role of SCO culture in relation to the contribution of SQM to firm’s internal quality performance. We apply contingency theory, in contrast to universalist approaches to SQM to appreciate the fact that organisations in different supply chains, with different levels of SCO culture may yield different internal quality performance, therefore, we emphasis on adaptability of SQM to any given cultural context rather than a one size fits

all. In other words, this theory assists us to shed lights on the complexity and contingency of the relationship between SQM and internal quality performance and explicates that applying overarching best practice mantras will be inadequate to sharpen SQM practice applications in driving performance, especially in the current complex cultural environments among supply chain players. Grounded on this theory, the contingent role of SCO culture with respect to each dimension of SQM is discussed.

Organisations adopting SCO culture may have various criteria to select their suppliers in order to enhance their design and conformance quality. From a cultural perspective, organisations endeavour to select suppliers who are willing to take a greater responsibility for mutual SCM collaboration and are open to site evaluation (Kannan and Tan 2002). These two criteria imply that there must be a strong SCO culture within the supply chain. An SCO culture has the potential to make organisations demonstrate a high level of trust and commitment to their supply chain partners and to fulfil their expectations (Zhang et al. 2018). Moreover, Mello and Stank (2005) elaborate that a high level of organisational compatibility (as one of the shared values of SCO culture), results in organisations choosing suppliers that are compatible in goals and objectives.

Mello and Stank (2005) suggest that organisations with stronger SCO culture tend to select suppliers who have a high level of willingness and capability in establishing information, risks and rewards sharing, long-term relationship and service goal with their partners, as well as cross-functional integration, collaboration and key processes. In other words, selecting a supplier that melds with its buying organisation's SCO culture enhances shared information and knowledge and increases inter-organisational compatibility between the organisation and its supplier's goals – thereby improving the quality performance of the products (Emmett and Crocker 2016). Taking this contingency approach, Han, Huang and Macbeth (2018) highlight the significance of reinforcing

cooperative and shared norms among supply chain partners (known as one of the five aspects of SCO culture). Such cooperative working relationships between supply chain partners could result in a shared understanding of quality requirements and expectations of products (McAfee, Glassman and Honeycutt 2002). It can therefore be argued that an organisation enhances its design quality and conformance quality, if it demonstrates a high level of SCO culture the latter of which enables the organisation to carefully select and support its suppliers. In other words, the literature review for the SCO contingency variable led to the following research hypothesis:

H4. *The impact of supplier selection on (a) design quality and (b) conformance quality is positively associated with high SCO culture.*

Brix-Asala and Seuring (2019) posit that supplier development includes all efforts that are devoted to enhance suppliers' capabilities in order to work as an integral part of a supply chain and fulfil a focal organisation's needs as well as achieving suppliers' individual objectives. Prior research (e.g., Salimian, Rashidirad and Soltani 2017) demonstrates that such contribution of supplier development on the organisations' performance may not be universal to be investigated in isolation, while a more pragmatically applied contingent approach should be applied. Adopting this contingency view requires managers to perform flexible to capture the influence of culture in the supply chain environment to maximise the value creation. This may not be thoroughly achievable, if organisations do not have an SCO culture to work as one within their supply chain. Through a set of key values of SCO culture such as cooperative norms along with strong management support (Schulze-Ehlers et al., 2014), an organisation is able to combine its efforts with its suppliers (Mello and Stank 2005) and strengthen the impact of supplier development programmes on its internal quality performance. In fact, an organisation with strong SCO culture tends to undertake supplier development activities

more efficiently and effectively and consequently increase suppliers' performance. Overall, a strong SCO culture supported by high levels of trust, commitment, cooperative norms, compatibility and top management commitment encourages suppliers to get actively involved in supplier development activities and capitalise on it as an effective mechanism to initiate internal quality improvement (Li et al., 2012).

Such insights can be explained by briefly examining behaviour-based approaches in supply chain quality management (Zu and Kaynak 2012). In order to create value and achieve higher customer satisfaction, this approach lays stress on 'coordination and integration of the business processes of both buyer and supplier to measure, analyse and improve quality of products, services and processes' (Zu and Kaynak 2012, 430). It is built upon open communication, information sharing, monitoring supplier work processes and closer working relationships with suppliers (Ali 2020). These features correspond to the fundamentals of a strong SCO culture and are deemed essential to effectively manage supplier development activities. In short, it is argued that adopting a strong SCO culture can facilitate the ability of an organisation to effectively manage its supplier development programmes which in turn can improve the quality performance of the organisation as a whole. Thus,

H5. *The impact of supplier development on (a) design quality and (b) conformance quality is positively associated with high SCO culture.*

Out of the five shared values of SCO culture, trust and commitment are clearly associated with supplier integration. Kim et al. (2010) posit that inter-organisational trust and commitment are essential in any buyer-supplier relationship. A trustworthy relationship between an organisation and its suppliers may lead the organisation to demonstrate a high level of willingness to share its information, rewards and risks with its suppliers. In contrast, organisations with a low commitment to SCO culture may fail

to effectively manage their supply chain programmes and this can adversely impact on the quality of raw materials purchased (Omar et al. 2012b). According to Nir, Ding and Chou (2012), SCO culture invokes shared values and beliefs, mutual trust, information and knowledge sharing to enable supply chain members to achieve their goals through integration and collaboration. Their findings reveal that the enhancement in integration of supply chain members improves the performance of organisations and therefore the whole supply chain. In a similar vein, McAfee, Glassman and Honeycutt (2002) talk about the paramount importance of high levels of cultural consistency as a necessity for having long-term cooperation among members of the supply chain network. In short, buyer-supplier cultural congruence implies the higher cultural compatibility and consistency in goals and values, the more successful the supplier integration programmes, and consequently, the higher quality performance of the buyers (see Nir, Ding and Chou 2012). Thus, SCO organisations are committed to sharing their information, risks, and rewards with their suppliers, to manage their supplier integration successfully. Thus, SCO culture, as a contingency factor, may enhance participation levels of suppliers in the process of product design and production. This participation may have a positive impact on design quality and conformance quality of buying organisations. In sum, we propose that:

H6. *The impact of supplier integration on (a) design quality and (b) conformance quality is positively associated with high SCO culture.*

In light of the research aim and questions, and the proposed list of hypotheses, Figure 1 presents the conceptual framework that guides this study.

---Insert Figure 1 about here---

3. Methodology

3.1 Survey design

Based upon the research questions and the identified gaps, a structured questionnaire was designed to explore the relationships between the research variables. Following a questionnaire design process proposed by Neelankavil (2007), the initial draft of the questionnaire was carefully developed with respect to key design factors, i.e. length, arrangement, structure, wording, layout and flow. To complete the final step of the design process, the questionnaire was re-evaluated as follows: The first draft of the questionnaire was reviewed and modified by two expert groups ((i) academia who were specialists in the area of supply chain and quality management and (ii) business experts who were familiar with the area of this study within the four selected industries). As a result, some changes were made to improve both the layout and content of the questionnaire.

As a result of an extensive review of the relevant literature, a questionnaire was drafted in three main sections where each of the research constructs was operationalised through some seven measures on average (see Appendix A). The first section of the questionnaire analysed SQM (independent variable) in the three sub-sections of supplier selection, supplier development, and supplier integration. In the supplier selection sub-section, respondents were asked to weigh the significance of seven measures in selecting a key/preferred supplier for their organisation. The second sub-section of independent variable examined the extent to and manner in which an organisation develops its suppliers through various practices, such as training, and providing them with support and advice. Likewise, seven measures were taken from prior work to measure supplier integration. The second section of the questionnaire was devoted to the dependent variable, i.e. internal quality performance. Questions in this section were also designed in the form of positive statements in which the respondents were required to weigh the degree of their agreement with the statements through the 7-point scale of Likert. Finally, in order to investigate the moderating effect of SCO culture, five measures were used

which were adopted from the studies of Mentzer et al. (2001) and Mello and Stank (2005) (see Appendix A).

To reduce the confounding effects of contextual factors on the relationship between SQM and internal quality performance, two variables were considered as control variables, i.e., organisational size and SQM duration. It has been suggested that the flexibility of resource allocation to the activities of supplier selection and supplier development, is higher in larger organisations compared to smaller ones (Koufteros, Cheng and Lai 2007). Regarding the second control variable, i.e., SQM duration, Powell (1995) suggests that longer quality management duration has an improving effect on some quality management practices. In the context of SCM, it is suggested that long-term SQM implementation may increase the commitment of suppliers to participate in supplier development practices that are supported by buying organisations. In addition, respondents were asked to respond to the questionnaire with reference to existing practices and data. It is assumed in the research that all responses are objective in this way. As can be seen in Appendix A, all items in the questionnaire were developed based on prior reliable sources on the research phenomena, so the content or logical validity of the research instrument was secured.

3.2 Pilot testing

Upon completion of the survey instrument, a pilot test was undertaken to ensure (i) the reliability of the scale, (ii) comprehensiveness of the contents, and (iii) appropriate wordings of the survey. To do so, some 200 questionnaires were distributed to a sample of manufacturing organisations operating in four industries (i.e. electronics, chemical, plastics and precision mechanics) and yielded a 16% response rate (i.e. 32 fully completed responses: eight from electronics, six from chemical, ten from plastics and eight from precision mechanics). As a result of the pilot test, the survey was amended to measure the

constructs of interest. Furthermore, the coefficient alpha was used to ensure whether the chosen items of each construct represented the main aspects of the construct, by using an approach of alpha if an item is deleted. The analysis showed that the Cronbach's alpha for all items was over an acceptable level of 0.70 – indicating that the designed questionnaire was reliable enough to be employed for data collection.

3.3 Sampling technique

As the focus of this study was on the relationship between buying organisations and their first-tier suppliers, the Wagner (2003) classification of industries in terms of two phases of supplier integration (the development phase and the industrialisation phases) was employed. In order to control the potential moderating effect of industry type, one industry from each area of Wagner's classification was selected, including electronics, chemical, precision and plastics industries. In line with Wagner's classification, manufacturers of finished products in the four industries in the UK were selected. As such, the aggregate effect – as opposed to individual effect – of these four industries was considered. The research framework and its corresponding hypotheses were analysed based on an aggregate sample of these four industries.

Having chosen a web-based survey, an email invitation to request participation in the survey and the link to the online questionnaire (designed in Qualtrics) was sent to the potential participants in each industry. Key informants of each of the four industries (senior executives with purchasing/supplier/quality/operations management responsibilities) were asked to take part in the survey. To increase the response rate, the web-based inquiry was followed up by a two-round email reminder.

To improve the accuracy of our sampling technique and chosen sample of industries, particular attention was paid to marginal error and confidence interval. A total number of 2800 manufacturing organisations across the four industries were randomly

selected from freeindex.co.uk – which yielded 518 completed questionnaires with a 18.5 percent response rate. Our response rate can be described as comparable with those reported in previous research on supply chain quality management – 6.3% to 20% (Gunasekaran, Patel and McGaughey 2004; Li and Lin 2006; Wong, Boon-itt and Wong 2011; Zhang et al. 2018). In order to ensure whether the data gathered from the early respondents could be combined to those returned after the reminders (late respondents), Chi-square test was undertaken to test for non-response bias. Analysing the results of this test demonstrated no significant difference ($p > 0.05$) between the early and late data collection and therefore the two sets of the data were combined for further statistical analysis.

This research employed a single report data collection method from each organisation, which had been largely used in other pertinent literature (e.g., Wong, Boon-itt and Wong 2011). In order to minimise the potential bias related to the single report dataset, data was collected from the most informant individuals in the participating organisations. In this research, while a majority of the respondents were in middle or upper level management roles in quality and logistics functions, some 11 percent of the participants had different but related managerial roles and functional responsibility (e.g., CEO, sales manager, ERP manager). Nearly 74 percent of the participating organisations ($n = 382$) were Small and Medium-sized Enterprises (SMEs) with less than 250 employees. Over one-fifth of the organisations were from the electronics industry, 24 percent from chemical, 27 percent from plastics, and the remaining firms represented precision mechanics.

3.4 Construct validity and reliability

In addition to undertaking face validity and content validity, Principal Component Analysis (PCA) was employed to ensure construct validity. Using SPSS v.20, a cut-off

point of 0.4 was set for removal of the items. Having carried out this analysis, three distinctive components of SQM (i.e. supplier selection, development and integration) were identified, which all together, explained 84.17 percent of SQM variance. In a similar manner, internal quality performance was presented through two components of design quality and conformance quality, describing 83.17 percent of the total variance. Cronbach's alpha was performed to ensure scale reliability. All constructs obtained an alpha score of greater than 0.7. Pearson Product-Moment Correlation Coefficient (PPMCC) was employed to examine the possible relationship between factors. As shown in Table 1, the correlation coefficients were all positive, however, the degree of the correlations varied from low (PPMCC= 0) to medium (PPMCC= 0.693) range correlation, indicating that multicollinearity was not expected to be a major problem. Following Chapman (1989), the second test of multicollinearity problem was conducted by calculating the R squared of each independent variables. These squared scores were not too large (all less than 0.45) to indicate definite multicollinearity problems. Moreover, endogeneity test was performed before we proceeded to regression analyses. Following prior studies (e.g., Liu et al. 2016; Dubey et al. 2019), we empirically tested to find out whether endogeneity was an issue by conducting the Durbin-Wu-Hausman test (Davidson and MacKinnon 1993). The results confirmed that none of our research variables was endogenous in our setting and they were all consistent with their conceptualisation.

----Insert Table 1 about here----

3.5 Data analysis

As demonstrated in Table 2, six models were constructed. In all models, simple linear regression applied to assess the causality between each SQM dimension and two aspects

of internal quality performance, i.e., design quality (models 1-3) and conformance quality (models 4-5). Given the strength and advantages of this method and consistent with the prior research on SQM (e.g. Bagchi and Ha 2005), regression, as a broadly applicable method (Jackson 2011) was selected to build, estimate and test the overall model fit ensured by examining the proposed hypotheses.

MODEL 1 investigates the impact of supplier selection on design quality. As Table 2 illustrates, the contribution of supplier selection to design quality is insignificant. By using this model, only 3.8 percent of design quality is explained by supplier selection. This indicates that supplier selection may not be a good predictor of design quality. The association of supplier development with design quality is investigated in MODEL 2. As the results exhibit, supplier development significantly influences design quality. This model represents a higher R squared ($= 0.457$), compared to MODEL 1, implying that nearly 46 percent of variance in design quality could be described by supplier development. Thus, enough evidence exists to support H2a. MODEL 3 explores the link between supplier integration and design quality. As Table 2 shows, MODEL 3 represents the undeniable impact of supplier integration on the outcome. This demonstrates that as the integration between an organisation and its first-tier supplier increases, design quality is improved.

----Insert Table 2 about here----

MODELS 4, 5 and 6 make an attempt to shed light on the relationship between SQM dimensions and conformance quality. In respect of MODEL 4, a similar argument to that of MODEL 1 can be presented. The results illustrate that supplier selection does not improve conformance quality. Similar to H2a, MODEL 5 implies that the higher an organisation's supplier development activities, the higher the level of conformance quality. This in turn results in H2b being fully supported. Finally, H3b underscores the

fact that the higher the integration between a manufacturer with its tier one suppliers, the greater the ability of the manufacturer to enhance its conformance quality. Thus, the findings support H3b.

To investigate the remaining three hypotheses (H4-H6), a hierarchical regression analysis was employed and the following procedures were followed accordingly. The hierarchical regression analysis required running three models for each dependent variables (i.e., models 1-3 for design quality, and 4-6 for conformance quality) as follows. In models 1 and 4, the potential impact of the independent variables on the dependent variables were explored. In models 2 and 5, the impact of both independent and contextual factors on the dependent variables were assessed. Finally, models 3 and 6 added the interaction of both independent and moderator variables to the previous models (2 and 5) to obtain the most comprehensive models. In all models, organisational size and SQM duration were treated as control variables.

As demonstrated in Table 3, although the impact of supplier selection on design quality was found insignificant (see the result of H1a in Table 2), the inclusion of SCO culture did not change the result. Similarly, the impact of SCO culture on the supplier selection-conformance quality link was found to be insignificant (see MODEL 6 in Table 3). As a result, both H4a and H4b are rejected. This finding is consistent with previous research (e.g., Shin, Collier and Wilson 2000; Nair, Jayaram and Das 2015) which suggests that supplier selection itself may not be a grantor of quality in firms, whereas a combination of selecting an appropriate supplier and other SQM activities to monitor, manage, and develop the supplier ensure that the benefits of supplier selection translate into better internal quality in organisations.

----Insert Tables 3 about here----

With regard to H5a-b, the results in MODEL 3 of Table 4 indicate a significant relationship between SCO culture and design quality, under H5a. In the next step, the conjunction of this moderator with supplier development and conformance quality presented significant results (see MODEL 6). As can be seen in Table 4, the inclusion of the interaction effect resulted in a higher R squared compared to MODELS 5 and 4. Thus, both H5a and H5b are supported.

----Insert Table 4 about here----

The last hypothesis (H6a-b) was tested through the same sets of regression analysis. The results are illustrated in Table 5. H6a explored the potential moderating effect of SCO culture on the relationship between supplier integration and design quality. Since the interaction terms, i.e. supplier integration $\times$ design quality (introduced in MODEL 3) accounted for a significant amount of incremental variance in the outcome, i.e. design quality ($R^2 = 0.559$), there was evidence to underpin the moderating influence of SCO culture. This implies that as the SCO culture increases, the strength of the association between supplier integration and design quality performance improves. An investigation into the moderating impact of SCO culture on the supplier integration-conformance quality relation revealed SCO culture significantly reinforced the strength of this relationship (see MODEL 6). Hence, both H6a and H6b are supported.

----Insert Table 5 about here----

4. Discussion

To scrutinise the relationship between different dimensions of SQM and internal quality performance, three hypotheses (H1-H3) were developed. Overall, two of these hypotheses (H2 and H3) were supported. The results suggest that supplier development and supplier integration had positive effects on the design quality and conformance quality. The results partially supported the findings of previous work (such as Shin,

Collier and Wilson 2000; Ho, Duffey and Shih 2001; Lo, Sculli and Yeung 2006) that supported the direct effect of SQM on quality performance. Our results indicated that supplier selection did not directly contribute to internal quality performance. This result substantiated previous findings in the literature contradicting the direct impact of quality-oriented supplier selection on organisational quality performance (e.g., Shin, Collier and Wilson 2000; Lo, Yeung and Yeung 2007). One possible explanation is that a firm's supplier quality management system could rarely perfectly fit into a firm's operations; as well as the potential challenges associated with fitting and mutual adaptations to further cement effective partnership and execute strategies effectively. It could be argued also, that recruitment processes might assume mutual understanding of production process, culture and expectations, but be challenged, in a healthy partnership working environment, leading to improvement in performance. A further examination regarding this result suggests that supplier selection (the first step of executing SQM process) determines the other SQM dimensions i.e., supplier development and supplier integration (Lo, Yeung and Yeung 2007). In this respect, our findings have close affinity with those of Shin, Collier and Wilson (2000) who lay stress on the indirect relationship between quality-driven supplier selection and organisational quality through the moderating impact of supply quality. This suggests that while supplier selection has a role to play in the quality of product design and development during the early phases of manufacturing, what matters most is whether and how a buying organisation develops and integrates its quality and logistics management processes into those of its suppliers once the supplier selection choice has been made.

The findings of this study lend support to the direct impact of supplier development on design quality (H2a) and conformance quality (H2b). The results confirm that the participating organisations improve their internal quality performance by

applying supplier development activities, such as quality training and supplier evaluation. Similar findings have been reported by previous research where supplier development and organisational quality performance were found to be closely interrelated (see Lo, Sculli and Yeung 2006) and that supplier development activities such as quality training programmes were reported to positively enhance internal quality performance (see Jayaram, Ahire and Dreyfus 2010).

In terms of the relationship between supplier integration and internal quality performance, the research hypothesis (H3a-b) is supported, suggesting that design quality and conformance quality of the manufacturers significantly improves by using supplier integration activities. This is consistent with several previous studies (e.g. Zhao, Cavusgil and Cavusgil 2014; Duhaylongsod and Giovanni 2019) in that integration between organisations and their suppliers in terms of sharing information can reduce any misunderstanding between the supply chain members and that the latter assists organisations to enhance their design quality and conformance quality. Moreover, our results indicate that suppliers' involvement in the design and production stages of new product development by an organisation is highly likely to reduce the cost of scrap and rework and improves delivery time to the customers. These findings are similar to those of Zhao, Cavusgil and Cavusgil's (2014) study in a sense that supplier integration amplifies design quality of products by improving a shared understanding of product specifications between an organisation and its suppliers.

Our findings also lend support to the argument that supplier development-internal quality performance relationships (H5a-b) and supplier integration-internal quality performance links (H6a-b) would be more robust under a high level of SCO culture. The findings suggest that organisations with strong SCO culture are more willing to actively engage in supplier development activities. One explanation for this might be that the SCO

organisations are highly motivated to perform supplier development activities based on the premise that organisational performance is directly affected by supplier performance, but also that these activities can provide insight on potential revisions based on shared learning: reinforcing the concept of working as one. This finding is generally similar to those found in the previous studies (e.g. Hwang, Chung and Jin 2013; Salimian, Rashidirad and Soltani 2017) where cooperation in its multitude of forms among supply chain members (e.g. supplier development programmes) was reported to be stronger if there was a high level of SCO culture among the supply chain parties.

Finally, the results of this study support the argument that the supplier integration-internal quality performance relationship is positively moderated by SCO culture. This is largely because organisations with high levels of SCO culture tend to share information with their suppliers – owing to the existence of a level of trust between them. These findings are largely consistent with prior research studies (e.g., Mello and Stank 2005; Cao et al. 2015) which suggest that SCO culture strengthens supplier integration through promoting cooperation and commitment between an organisation and its first-tier suppliers.

5. Conclusion and implications

5.1 Theoretical contributions

The relationship between SQM and quality performance has been examined in previous studies (e.g., Arumugam, Ooi and Fong 2008). However, to the best of our knowledge, no previous research results have explored SQM and its performance impact on internal quality as a dimension of quality performance. Therefore, this study contributes to the literature (e.g., Salimian, Rashidirad and Soltani 2017) through supporting the recommendation that the performance impact of SQM practices on quality should be analysed initially at intra-firm level; and hence an examination of SQM-internal quality

performance relationship would serve as a more objective indicator of the real impact of SQM activities on organisational performance. As such, a related contribution of the current study centres on the adopted approach to SQM conceptualisation. Unlike prior research (see Arumugam, Ooi and Fong 2008; Kaynak and Hartley 2008) that operationalised SQM and internal quality performance as uni-dimensional constructs, the current study conceptualises SQM-internal quality performance relationships as multi-dimensional variables. Thus, to the best of our knowledge, this study is one of the leading and comprehensive ones which examines the impacts of all three dimensions of SQM on two dimensions of internal quality performance in a single study.

Most previous research on supply chain quality has not only operationalised SQM and internal quality performance as uni-dimensional constructs, but also primarily adopted a universal approach to the SQM-internal quality performance relationship. In other words, the assumption was that the SQM-internal quality performance relationship was a linear one and that a linear, direct relationship was universally applicable in any organisation. Our study contributes to this stream of research by analysing the SQM-internal quality performance relationship through the lens of contingency theory and presents evidence in support of the context dependency nature of SQM and its performance quality impact. In this respect, a contextual variable theorised as ‘SCO culture’ was employed to moderate the SQM-internal quality performance relationship. We propose that consistent with Srinivasan and Kurey (2014) and Dubey and Gunasekaran (2015), that SQM must move beyond solely best practice, and prescriptive approaches which are mainly limited to stable environments. Indeed, our research framework supplements previous research (e.g., Lo, Yeung and Yeung 2007; Sousa and Voss 2008; McAdam, Miller and McSorley 2019), and lays foundations for further application of contingency theory to the study of SQM. This study contributes to the

extant literature (e.g., Emmett and Crocker 2016) through introducing SCO culture as a lesser investigated contingency factor which has the potential to moderate the SQM-internal quality performance relationship. Our findings suggest there is merit in buying organisations focusing on development of SCO culture both within their organisation and in creation of shared SCO culture if they wish to achieve a higher level of internal quality and organisational performance through an effective buyer-supplier relationship. As a result, we tried to contribute to the expansion of the explanatory power of contingency theory in relation to SQM and capitalises on the rich practitioner based knowledge discourse of contingency studies. The adopted contextual approach leads to grounded studies rather than prescriptive best practice solutions in SQM theory and practice, where scholars (e.g., Srinivasan and Bryan 2014) suggest that contextually grounded approaches are far more effective than best practice and rule based approaches to SQM.

5.2 Practical contributions

This research provides a clear steer to operations managers generally, and in particular for quality and logistics managers who intend to execute SQM systems in such a way that enhances internal quality and organisational performance. Poor quality raw materials have been frequently-cited as a major problem facing manufacturing organisations and that the total number of recalls per year has been climbing across various manufacturing industries in recent years (e.g., Ball, Shah and Wowak 2018; Hughes 2019). While it would be unfair to blame all members of the supply chain network equally, the root causes of this problem have been reported to be attributed to (i) a lack/insufficient attention to supplier development and integration programmes of the organisation with respect to its suppliers and (ii) a high level of misunderstanding between an organisation and its first tier suppliers about the characteristics of the products and their required quality levels. Thus, managers are highly suggested to empower their suppliers through investment on

their suppliers' development and integration practices, and establish and maintain a strong relationship with their suppliers to increase their products' design and conformance quality. Managers are advised to consider the proposed model as a constructive input for strategic and operational planning towards achieving the targeted quality goals. Another implication of this is the benefit provided indirectly to all the organisations in any industry, where, the outcome of this study reveals useful guidelines to quality managers on how to enhance their products' design quality and decrease the volume of recalls and defeats. Hence, practitioners should be prepared to change/upgrade SQM practices in line with increasingly complex and dynamic supply chain environment and move away from an isolated internal focused and mechanistic approach to a more holistic intra-focused and flexible approach.

Our empirical results show that organisations lacking a strong SCO culture are unlikely to achieve the highest level of internal quality performance, especially if they are working with a number of suppliers. In other words, our groundwork explicates the role of SCO culture in general, and initiates progress toward a shared vocabulary around SCO culture responsibilities (see Emmett and Crocker 2016). Thus, managers are advised to move beyond from establishing a supportive organisational culture towards suppliers to giving careful consideration to the effect of SCO culture on the effectiveness of SQM activities. Awareness of a contextually appropriate organisational culture for SQM requires general and operations managers to establish a strong, reliable and trustworthy relationship with members of supply chain networks. SCO culture requires managers and organisational strategists to substantially widen their scope of analysis from organisational boundaries to supply chain scale, and be aware that the stronger the level of trust, commitment, cooperative norms, compatibility and managerial support among supply chain members, the higher the level of organisational and supply chain

performance. In short, managers should view SCO culture as an essential facilitator in the establishment and cultivation of inter-organisational development and integration practices across the entire supply chain network. Hence, from a practice perspective, reflective practitioners need to move beyond archetypal best practice and prescriptive SQM practices to better spot the need to future change, considering a shift in existing internal operational practices to a strategic supply chain wide practices. Thus, this research tried to raise managers' awareness regarding contextual dependency of SQM activities and the fact that there is no best way to implement SQM for all organisations. Managers should be aware that they need to customise their processes based on their condition to implement SQM more effectively and enhance their quality performance.

Our research has several important implications for policy makers and other stakeholders in the UK manufacturing sector. Given the significant contributions of the manufacturing sector to the economy (some 10% of the UK's gross value) employing nearly 3 million people (Office for National Statistics 2019), the onus is on the UK government to devise a much wider set of activities that support businesses to create value for the UK and benefits for wider society. In this respect, the Government's industrial strategy should lay emphasis on cultivating a conducive business environment and culture that brings about higher levels of trust and commitment among all organisations within the supply chain, and creating value to the end customer – owing to the fact that manufacturing is no longer just about production.

In addition, our findings help the UK government to take its support for manufacturing to another level by encouraging focus on establishing effective and robust inter-industry linkages. This is largely because manufacturing performance not only affects other sectors through its wide range of input-output and other linkages but more importantly, it is more engaged in domestic, regional and global business relationships

with other members of upstream and downstream supply chain networks. Both government and relevant professional associations can raise awareness among practitioners and senior managers of supply chain quality management practices through government funded educational programmes and workshops. Given the size of SMEs and the government's plan to capitalise on their contributions to the economy (Statista 2019), tailored, high-quality practically-focused business and management education with a focus on intra- and inter-firm business relationships and the resulting performance outcomes should top the government agenda.

5.3 Limitations and Future Research

This study is restricted to collecting data from a sample of UK-based manufacturing industries and did not cover service industries. Given the dominant role of the service sector in the UK economy, follow up studies could explore the practice of supply chain quality management in business services such as those in the financial services industry. Furthermore, the current study examined the effect of SQM on internal quality performance. This would in turn offer an opportunity for OM scholars to gather data from customers to further assess their perceptions towards product/service quality. The unit of analysis in this study was the focal manufacturing firm and the data were collected based on the responses from the managers, which could be biased towards the firm. In future, a dyadic perspective from both the manufacturer and its supplier could be useful to understand whether the responses from the manufacturing firm are supported by the suppliers as well. This would also help to improve the reliability of the responses. Further research could also gain insight from contingency theory to analyse the moderating effect of other contextual factors (e.g., firm size, firm scope, industry type and SQM duration) on the relationship between SQM practices and quality/organisational performance outcomes. Using contingency theory, scholars are able to analyse other environmental

factors which may influence this relationship. In particular, given that this study was conducted in an aggregation of four manufacturing industries, further research can investigate the individual effects of these industries on the research phenomena. In light of the research areas suggested for future studies, this study opens a research avenue for other scholars to expand exploration on the relationship between SQM practices, SCO Culture and performance. Further studies are highly recommended to enrich the extant knowledge-base in the investigated research phenomena. Finally, due to the limitations of the adopted regression analysis in exploring the mediating analysis, and the capabilities of the alternative methods (e.g., PROCESS, see Hayes, Montoya and Rockwood 2017), future research may further strengthen the research findings.

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Figure 1- The proposed conceptual framework

Table 1. Pearson correlation coefficients

Variable names	Supplier selection	Supplier development	Supplier integration	Design quality	Conformance quality	SCO culture	SQM duration	Organisational size
Supplier selection	1							
Supplier development	0.000	1						
Supplier integration	0.000	0.000	1					
Design quality	0.196	0.598***	0.410***	1				
Conformance quality	0.163*	0.318***	0.572***	0.000	1			
SCO culture	0.208	0.652**	0.693**	0.528**	0.570**	1		
SQM duration	0.250	0.508**	0.556**	0.337**	0.662**	0.524**	1	
Organisational size	0.242	0.411**	0.538**	0.451**	0.370**	0.523**	0.519**	1

P* <0.1; P**<0.01, P***<0.001

Dependent variable: Design quality

P* <0.1; P**<0.01, P***<0.001

Table 3. Results for H4a-b

Dependent variable: Design quality						
	MODEL 1		MODEL 2		MODEL 3	
Independent variables	Beta	t value	Beta	t value	Beta	t value
Supplier selection	.196	1.532	.190	6.538***	.217	7.314***
SCO culture			.726	25.026***	.696	23.217***
Supplier selection $\times$ SCO culture					.111	3.585*
Control variables						
Organisational size	.673	20.226***	.184	4.755***	.127	37.490**
SQM duration	.021	1.092	.009	.223	.051	1.300
R squared	.038		.566		.577	
Dependent variable: Conformance quality						
	MODEL 4		MODEL 5		MODEL 6	
Independent variables	Beta	t value	Beta	t value	Beta	t value
Supplier selection	.163	3.745*	.168	5.274***	.195	5.965***
SCO culture			.671	21.054***	.701	21.264***
Supplier selection $\times$ SCO culture					.109	3.195*
Control variables						
Organisational size	.448	11.119***	.205	4.192***	.686	9.913**
SQM duration	.748	1.805	.071	1.757*	.094	2.515*
R squared	.026		.477		.487	

P* <0.1; P**<0.01, P***<0.001

Table 4. Results for H5a-b

Dependent variable: Design quality							
MODEL 1				MODEL 2		MODEL 3	
Independent variables	Beta	t value		Beta	t value	Beta	t value
Supplier development	.598	16.942***		.215	5.546***	.222	5.865***
SCO culture				.588	15.205***	.693	15.911***
Supplier development × SCO culture						.178	4.873***
Control variables							
Organisational size	.515	15.836** *		.205	4.38 6***	.158	3.427***
SQM duration	.044	1.085		.080	1.69 2*	.109	1.909*
R squared	.457			.557		.576	
Dependent variable: Conformance quality							
MODEL 4				MODEL 5		MODEL 6	
Independent variables	Beta	t value		Beta	t value	Beta	t value
Supplier development	.318	7.625***		.205	4.870***	.212	5.084***
SCO culture				.804	19.052***	.714	14.898***
Supplier development × SCO culture						.151	3.756***
Control variables							
Organisational size	.298	6.609***		.122	2.837**	.293	6.914***
SQM duration	.674	17.578** *		.269	6.566***	.203	5.289***
R squared	.201			.473		.487	

P* <0.1; P**<0.01, P***<0.001

Table 5. Results for H5e-f

Dependent variable: Design quality						
	MODEL 1		MODEL 2		MODEL 3	
Independent variables	Beta	t value	Beta	t value	Beta	t value
Supplier integration	.410	10.219***	.182	4.430***	.325	5.778***
SCO culture			.854	20.763***	.408	17.290***
Supplier integration × SCO culture					.158	3.673***
Control variables						
Organisational size	.712	16.882** *	.559	16.163***	.530	15.094***
SQM duration	.321	1.304	.029	.804	.006	.172
R squared	.268		.547		.559	
Dependent variable: Conformance quality						
	MODEL 4		MODEL 5		MODEL 6	
Independent variables	Beta	t value	Beta	t value	Beta	t value
Supplier integration	.572	15.823***	.206	4.638***	.362	5.946***
SCO culture			.527	11.834***	.360	5.710***
Supplier integration × SCO culture					.172	3.694***
Control variables	.021	.440	.087	1.287	.004	.061
Organisational size	0.405	2.403	.071	1.757*	.065	1.618
SQM duration						
R squared	.427		.471		.484	

P* <0.1; P**<0.01, P***<0.00

Appendix A: Survey instrument

Section 1: Supplier Quality Management	
<u>Supplier selection</u>	
How important are the following factors when selecting a key/preferred supplier for your organisation? Adopted from: Kannan and Tan (2002); Lo and Yeung (2006) Range: Extremely unimportant- Extremely important (7-point Likert scale)	
SS1	Having a reliable quality assurance system
SS2	Willingness to integrate supply chain management relationship
SS3	Commitment to continuous improvement in product and process
SS4	R&D capabilities
SS5	Having sufficient design and technical capabilities to ensure quality
SS6	Supplier's willingness to share confidential information
SS7	Open to site evaluation
<u>Supplier development</u>	
This part asks you some questions about the activities which are used by your organisation to enhance the abilities of your suppliers. Adopted from: Wen-li et al. (2003); Lo and Yeung (2006); Carr and Kaynak (2007); Wagner and Krause (2009); Ghijssen, Semeijn and Ernstson (2010) Range: Totally disagree- Totally agree (7-point Likert scale)	
SD1	We evaluate suppliers' price, quality and delivery performance regularly through a supplier rating system.
SD2	We provide our suppliers with training/education.
SD3	We provide our suppliers with equipment or tools for process improvement
SD4	We provide our suppliers with capital for new investments at their facilities.
SD5	We give manufacturing related advice to our suppliers (e.g. processes, machining process, machine set up)
SD6	We give quality related advice to our suppliers (e.g. use of inspection equipment, quality assurance procedures)
SD7	We collaborate with our suppliers in improvement and development activities for new raw materials and parts.
<u>Supplier Integration</u>	
This part asks you some questions about the activities which are used by your organisation to integrate with your first tier suppliers. Adopted from: Paulraj and Chen (2007); Jayaram (2008); Chen, Daugherty and Roath (2009) Range: Totally disagree- Totally agree (7-point Likert scale)	
SE1	Our organisation along with our major suppliers tries to develop common goals to align process efforts.
SE2	Our organisation along with our major suppliers uses common standards to link processes smoothly across organisations.
SE3	Information and materials flow smoothly between our suppliers and us.
SE4	Our organisation shares design knowledge with key suppliers.
SE5	Our organisation communicates with key suppliers during first prototype stage.
SE6	Our organisation communicates with key suppliers during full production stage.
SE7	Our organisation involves key suppliers in setting design specification.
Section 2: Internal quality performance	
<u>Design quality</u>	
In this section, we would like to know about your internal quality performance. We ask you to give your evaluation of what your feel has come out of your organisation's quality performance. Adopted from: Swink (2000); Fynes, Voss and De Burca (2005); Petersen, Handfield and Ragatz (2005) Range: Totally disagree- Totally agree (7-point Likert scale)	
DQ1	Our designed products meet technical performance.
DQ2	Our designed products meet the customers' criteria for material.
DQ3	Our designed products meet the customer criteria for cost.
DQ4	Our designed products meet the criteria for ease of production and or assembly.
DQ5	Our designed products are easy for our supplier to execute.
DQ6	Unique features are provided for our special customer requirements.

DQ7	Our average number of engineering change orders in first year after product introduction due to production problems is low.
<u>Conformance quality</u> This part asks you some questions to measure the quality of your manufactured products. Adopted from: Fynes and Voss (2002); Kaynak (2003); Fynes, Voss and De Burca (2005) Range: Totally disagree- Totally agree (7-point Likert scale)	
CQ1	The cost of scrap is a low percentage of our product cost.
CQ2	The cost of rework is a low percentage of our product cost.
CQ3	We deliver the products to our customers in a short time.
CQ4	We have low defect rate for our products at final inspection.
CQ5	We have internal yield for our new products introduction.
Section 3: Contextual factor <u>Supply Chain Oriented Culture</u> In this section, we would like to ask you some questions about the level of SCO culture in your organisation. Adopted from: Mentzer et al. (2001); Omar et al. (2012b); Mello and Stank (2005) Range: Totally disagree- Totally agree (7-point Likert scale)	
SCO1	Our organisation trusts its internal and external supply chain partners.
SCO2	Our organisation is committed to long-term supply chain relationships.
SCO3	Our organisation establishes cooperative norms in relationships.
SCO4	Our organisation seeks out other supplier organisations that are compatible in goals and objectives.
SCO5	Our top management supports SCM activities.
Background <u>Industry type</u>	
IT1	What is the industry that your organisation is working in? Electronics ☐ Chemical ☐ Plastic ☐ precision mechanics ☐
<u>Organisation size</u> Extracted from: Sila (2007); Jayaram, Ahire and Dreyfus (2010)	
OS1	What is the total number of employees in your company? <250 employees ☐ > 250 employees ☐
<u>Supplier Quality Management duration</u> Adopted from: Powell (1995); Ahire, Golhar and Waller (1996); Jayaram, Ahire and Dreyfus (2010)	
SQMD1	How long have you trained your suppliers' personnel? ☐ Less than 1 year ☐ between 1 and 3 years ☐ more than 3 years
SQMD2	How long have you worked with your current major suppliers? ☐ Less than 1 year ☐ between 1 and 3 years ☐ more than 3 years
SQMD3	How long have you made contract with your major suppliers? ☐ Less than 1 year ☐ between 1 and 3 years ☐ more than 3 years