THE IMPACT OF CUSTOMER-SPECIFIC REQUIREMENTS ON SUPPLY CHAIN MANAGEMENT

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ABSTRACT

The complexities of being a supplier to motorcar manufacturers, also known as original equipment manufacturers (OEMs), provide an array of challenges to component manufacturers. Customer-specific requirements (CSRs) add to the convolutions of a supplier's quality management systems when producing components for the various motor manufacturers. The catalytic converter industry (CCI) forms part of the component supply chain in the motor industry. The CCI consists of a plethora of suppliers to produce the catalytic converter. This paper focuses on three of the five main suppliers, namely the 'monolith substrate manufacturers', the 'coaters', and the 'canners'. Most OEMs required that critical and strategic suppliers should be ISO/TS 16949:2009 certified. ISO/TS 16949:2009 refers to an internationally recognised specification, specifically adapted for the motor industry. The specification indicates the minimum requirements and also makes provision for additional requirements known as CSRs that can be specified by the OEM.

INTRODUCTION

In the automotive industry, the OEMs like Ford, General Motors and Volkswagen, select the supply chain and nominate the first and lower tier suppliers. Some French OEMs, like Peugeot, require that the first tier suppliers select the lower tier suppliers. The OEM has the right to introduce additional mandatory requirements also known as CSRs. In some cases these requirements are only made known after the business has been awarded to the supplier(s). CSRs that are requested after the business has been awarded can adversely impact on profitability and in some cases on productivity. Lower tier suppliers can be requested to comply with CSRs from higher tier suppliers and those from the OEMs.
Some OEMs have introduced additional CSRs to ensure sustainability of quality from suppliers in developing countries. The introduction of quality systems basics by GM for developing countries like Brazil and South Africa is an example of CSRs.

The OEMs require suppliers to be ISO/TS 16949 or ISO 9000 certified through an accredited certification body. For the OEMs these certifications provide assurance of greater consistency and discipline in suppliers' manufacturing processes.

Background to the research problem

ISO/TS 16949 makes provision for each OEM to document their unique CSRs. For organisations that manufacture generic components for the various motor manufacturers, CSRs add to the complexity of activities related to quality management systems. Applying multiple prescribed and specified CSRs from each OEM and higher tier suppliers can lead to complexity in the supply chain.

Catalytic converters

The catalytic converter supply chain consists of the substrate supplier, the coater, the mat supplier, wire mesh supplier and the canner. The 'canner' fits the coated substrate in a canister that forms part of the exhaust system.

The purpose of the catalytic converter is to convert harmful pollution into less harmful emissions before the exhaust fumes leave the exhaust system of the car's engine.

Catalytic converters typically consist of a ceramic or metal honeycombed monolith substrate that carries precious metal catalysts. The coated substrate is wrapped in a mat that secures and insulates the substrate when being canned. Figure 1 reflects catalytic converters after the coating process, while Figure 2 reflects a dissected schematic depiction of a completed canister after the canning process. Figure 3 reflects a complete canister such as would be fitted to the motor car's exhaust system.

Figure 1: A pile of platinum-lined catalytic converters (source: Amos, 2009: Online)

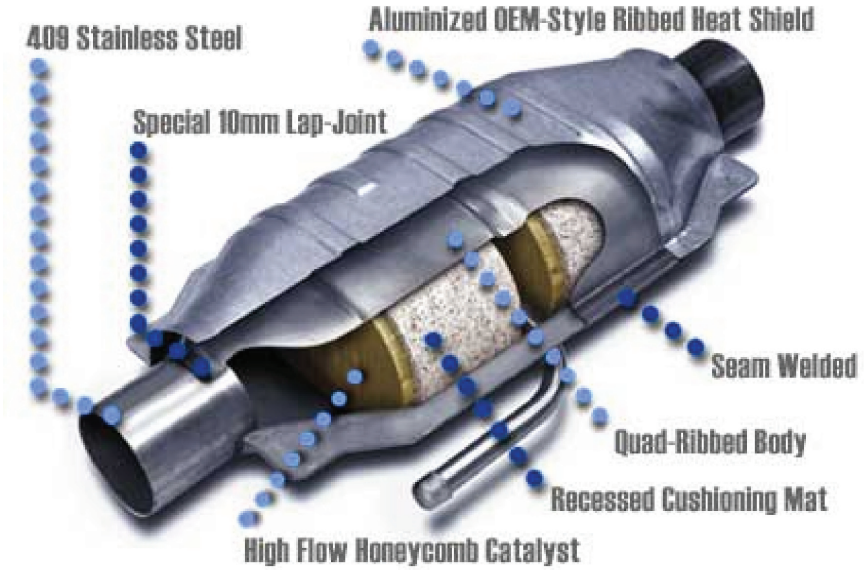

Figure 2: Dissected schematic of the components of a catalytic converter (source: Anonymous 1, 2009: Online)

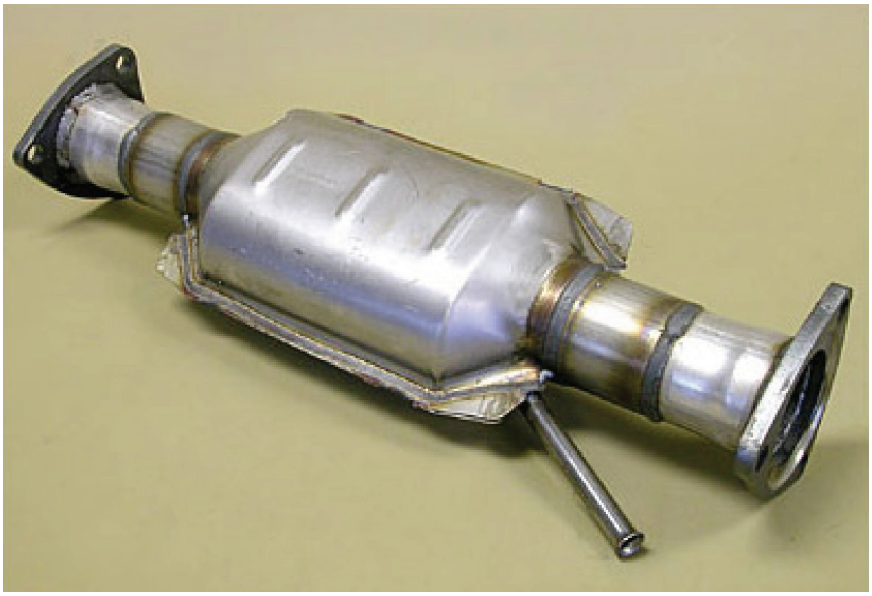

Figure 3: A completed under-floor catalytic converter as part of the exhaust system (source: Anonymous 2, 2009: Online)

The catalytic converter industry (CCI) forms part of the component supply chain to the motorcar manufacturers. The catalytic converter supply chain consists of the following third tier suppliers, namely: substrate suppliers, the mat suppliers and the wire mesh suppliers. The coaters are second tier suppliers, and the canners are first tier suppliers. *Table I* depicts the three key suppliers in the CCI supply chain. *Figure 4* depicts the CCI supply chain in South Africa.

Table I: Key supply chain flow in the catalytic converter industry (source: own)

Substrate suppliers	Coaters	Canners
Third tier suppliers • Produce monolith ceramic substrates. • The inner core simulates a honeycomb. • Supply the honeycomb substrates to the coaters.	Second tier suppliers • Apply wash coating and precious metals like platinum, rhodium and palladium to the surface area of the substrates. • Apply various coating techniques to minimise cost and optimise the catalytic characteristics. • Supply to the canners.	First tier suppliers • Place the coated substrates in an aluminium canister. • Place a 'mat' around the coated substrate before canning. • Place a wire mesh between substrates where more than one substrate is fitted in a canister.

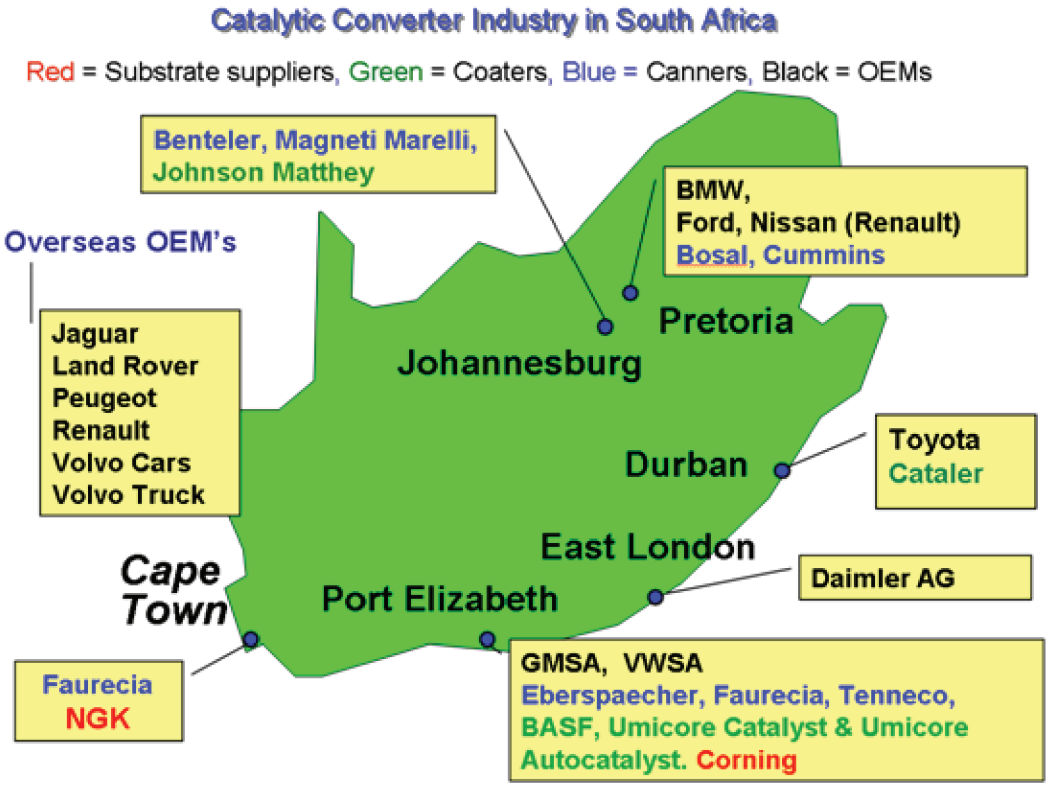

Figure 4: Geographic location of the catalytic converter supply chain in South Africa (source: Anonymous 3, NGK Ceramics South Africa: 2009, Presentation)

The complexities in context

Lorentzen and Barns (2004: 471) describe the complexity of the motor industry – the system of relations between vehicle assemblers and the component and part suppliers. They indicate how 'lean production' methods affect the entire value chain, whereby even the third tier supplier has to accommodate engineering changes.

Söderquist and Motwani (1999: 1107-22) indicated that the automobile industry provides a compelling example of how US and European carmakers, who historically relied on mass production techniques, have shifted their focus to 'lean production', in order to produce cars lower in cost and higher in quality than their Japanese counterparts. The key issue in achieving 'lean production' is that firms must learn to view the process of managing as a total inter-firm system within entire production chains, and not as a collection of independent techniques applied in independent companies.

Doran (2004: Online) wrote on modular supply chains in the motor industry, rather than the typical value chain, which is non-modular. Doran (2004: Online) defines 'modular' as a chain of activities whereby the smaller subsystems can be designed independently, and yet contribute to the end product as a whole. Furthermore, he explains that a continuum of first tier suppliers ranges from 'mature' through 'developing' to 'fringe' first tier suppliers. The module supplier benefited in terms of the increased responsibility, the greater involvement in development and design processes, and a higher proportion of value-creation activity.

Quality management system initiatives in the motor industry

First tier suppliers must be ISO/TS 16949 certified. The minimum requirement for lower tier suppliers is ISO 9001 certification. ISO/TS 16949 certification is done by independent certification bodies that are registered by the International Automotive Oversight Bureau (IAOB).

Traditionally, performance measures and indicators have been derived from cost-accounting information, often based on outdated and arbitrary principles (Oakland, 2000: 117). According to Oakland (2000: 118), total quality management (TQM) emphasises the need to start to measure the process for fulfilling customer needs. The critical elements for good performance measurements include leadership and commitment, full employee involvement, good planning, sound implementation strategy, measurement and evaluation, control and improvement, and achieving and maintaining standards of excellence (Oakland, 2000: 118).

According to Tsai (1998: Online), the cost of quality (CoQ) information can be used to indicate major opportunities for corrective action and to provide incentives for quality improvement. Tsai (1998: Online) discusses the numerous approaches to measuring CoQ, and categorises quality cost into a prevention-appraisal-failure model (Tsai, 1998: Online citing Feigenbaum, 1956).

According to a publication from the Automotive Industry Action Group (AIAG, 2009: Online), the approach is to create a common platform whereby players in the motor industry can share, learn and positively contribute to create a work environment that enables both the OEMs and suppliers to benefit.

Bailey (1994: Online) maintains that the old adage, 'the customer is always right' was never intended to turn those who deal with customers into doormats, nor to act as a catch-all for those who want to make unreasonable demands in an unpleasant way. Customers' rights must be recognised and protected. Organisations depend on customers and must view and treat them as important and must have strong customer focus. According to New (1997: Online) supply chain management is about the mechanisms and processes by which these activities are organised.

According to Sureshchandar, Rajendran and Anantharaman (2001: 343-63), the subject of quality management in the manufacturing industry has been a matter of increasing interest, but also of concern.

The core activity of manufacturing is no longer confined to making things, but lies in the systematic processing of knowledge to create value for customers (Choy & Lee, 2002: Online). Any change in strategy should enable manufacturers to be better equipped with capabilities to cope with demands such as faster response to the market changes, shorter lead time of production, improved quality products and speed, improved communication and transportation systems, which are commonly referred to as case-based reasoning (CBR).

RESEARCH PROBLEM

Multiple CSRs from the OEMs could lead to complexities in the supply chain. The introduction of ISO/TS 16949 was intended to minimise this impact on suppliers who have multiple quality manuals to comply with the requirements of various OEMs.

The question is, what remedial actions can be formulated that would accommodate the demand of OEMs for CSRs while minimising the impact on the supply chain?

RESEARCH DESIGN

An empirical investigation was conducted focusing on the three strategic suppliers in the catalytic converter industry. Within the context of methodological triangulation (Gallier and Land, 1987: 900-01), data was collected using interviews (Cooper & Schindler, 2006: 20), and questionnaires (Remenyi, Williams, Money & Swartz, 2002: 290).

Research assumptions

The following research assumptions were defined:

- The OEMs have the right to request new requirements from their suppliers irrespective of the supplier status or rating.
- The component suppliers are obligated to meet all requirements they are subjected to by the OEM to ensure future business.

- Management systems must be robust to prevent defective components reaching the customer, but also flexible to absorb new requirements.

Participants/respondents

The sampling frame defined by Vogt (1993) and cited by Collis and Hussey (2003: 155-60), is 'a list or record of the population from which all the sampling units are drawn'. Therefore the sampling frame consisted of five coaters, representing the entire population of manufacturers in South Africa; four canners randomly selected from a population of six; and three OEMs based in South Africa (Figure 5). This resulted in 12 role-players from different organisations in the industry being randomly selected from the following identified research strata:

- the coaters
- the canners
- the OEMs.

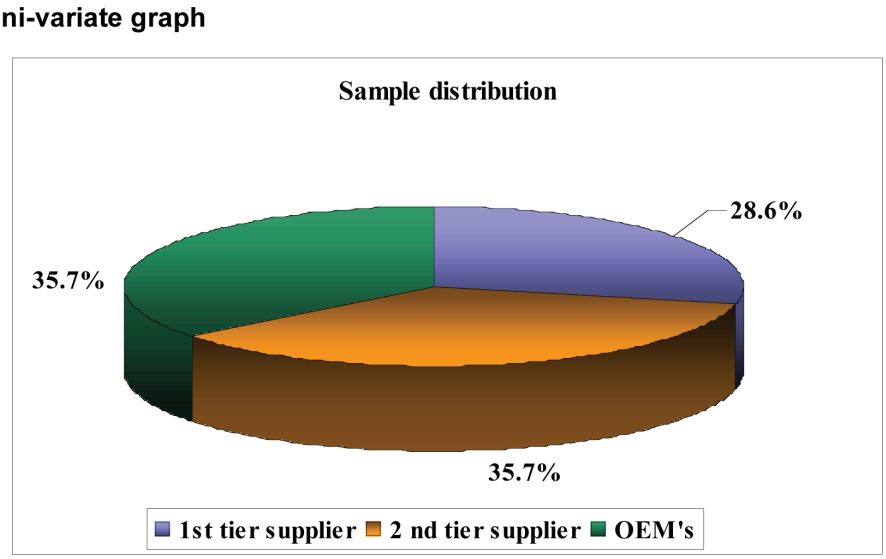

Figure 5: Pie graph with 3D visual effect for the sample distribution

Measuring methods of data-gathering

In the survey the methodological triangulation method was used which culminated in data collection through questionnaires and interviews. The data collection method used in the survey falls within the context of a survey, defined by Collis and Hussey (2003: 60) as 'a sample of subjects being drawn from a population and studied to make inferences about the population'. The survey was based on the well-known Likert scale, whereby respondents were asked to respond to questions or statements (Parasuraman, 1991: 410). Two separate survey questionnaires were developed. Due to the fact that face-to-face interviews are highly structured, questions were prepared and piloted to ensure they reflected a high degree of 'validity' (Babbie, 2005: 285).

Reliability testing

Cronbach's alpha is an index of reliability associated with the variation accounted for by the true score of the 'underlying construct'. Construct is the hypothetical variable that is being measured (Cooper & Schindler, 2006: 216-17). More specifically, Cronbach's alpha test measures how well a set of items (or variables) measures a single uni-dimensional latent construct.

Analysis

Data analysis refers to the process of bringing order, structure and meaning to the mass of collected data (De Vos, 2002: 339). The data received from the survey and interview questionnaires was in Microsoft Excel format. It was then imported into SAS format through the SAS ACCESS module.

Inferential statistics

Cronbach's alpha test was applied to test for reliability; the Kruskal Wallis test for interval data with more than two independent samples; and the Mann-Whitney U test or Wilcoxon rank-sum test for ordinal data with two independent samples. The Mann-Whitney U test (also called the Mann-Whitney-Wilcoxon [MWW], Wilcoxon rank-sum test, or Wilcoxon-Mann-Whitney test) is a non-parametric test for assessing whether two samples of observations come from the same distribution. The null hypothesis is that the two samples are drawn from a single population, and therefore that their probability distributions are equal. Chi-square tests are done for nominal data.

RESULTS

Statistically the second tier suppliers agree significantly more than the first tier suppliers that their company's quality management system is susceptible to errors that can lead to non-conforming conditions when subjected to multiple CSRs (Figure 6).

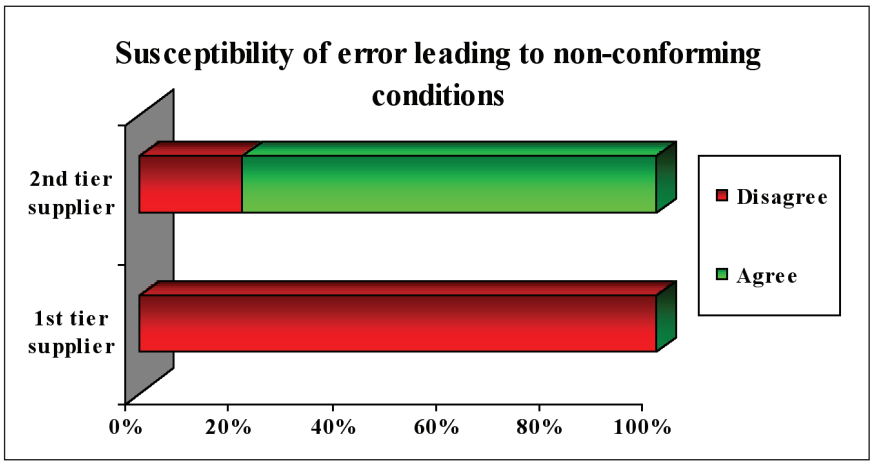

Figure 6: 100% stack bar for first and second tier comparisons

The analysis and inferential statistics concluded that the following issues should be addressed with respect to the suppliers:

- The OEM does not substitute costs for implementing new CSRs, when the new requirements require modifications to the system or processes.
- The flexibility required to adapt to CSRs does not make the quality management system effective.
- The OEM does not necessarily provide training on CSRs.

The issues that should be addressed with respect to the OEMs are:

- The automotive manufacturers do not necessarily ensure that all tier suppliers adhere to CSRs.
- The intent of CSRs is not necessarily the reduction of cost while the productivity increases from all suppliers.
- The automotive manufacturer does not necessarily provide financial support to implement new CSRs to all suppliers.

CONCLUSION

The following recommendations are made to mitigate the research problem:

- There should be more support from OEM representatives to second and lower tier suppliers to deflect the challenges faced by the suppliers to comply with multiple CSRs.
- Mutually beneficial relations should culminate in partnerships between OEMs and suppliers, rather than a directive approach from the OEM to ensure compliance.
- Lower tier suppliers should insist on more OEM support and involvement to prevent duplication of activities to ensure that each CSR is met.
- Lower tier suppliers must assess their activities regarding CSRs and their quality management system (QMS) to ensure that their QMS is robust instead of meeting the minimum requirements.
- Advance Product Quality Planning (APQP) meetings must be established by supply chain partners, not only at production part approval but also during serial production to ensure that supply-related concerns are addressed. These meetings can be on an *ad hoc* basis when the concerns are identified.
- The OEM should adopt a consultative approach with their supply chain to obtain buy-in from suppliers when improvements are required regarding product quality and service delivery from the supply chain.
- The OEM must ensure that tenders for new business do not force suppliers to offer tenders that will adversely impact the suppliers' business when the need for additional CSRs are issued to suppliers.

- The cost effectiveness of suppliers' tenders should be evaluated to ensure sustainability of supply and service delivery.
- The awarding of tenders should not be based on price alone, but should incorporate infrastructure requirements. As a result CSRs should be addressed at the request for quotation stage to ensure and assure compliance from potential suppliers.

During the interviews conducted with representatives from the OEMs, it was suggested that the intention of the OEM is not to force CSRs onto suppliers, but rather to identify the need to conform and therefore reduce poor quality products and services to reach the OEM. It was acknowledged that if the supplier has a stringent QMS and can prove that their QMS meets or has similar activities to the required CSRs, that the OEM supplier quality representatives would accept the supplier's system.

It can be concluded that the impact of CSRs on supply chain management has significant impact on lower tier suppliers. Lower tier suppliers are more susceptible to changes and additional requirements from the OEMs than first tier suppliers. This can be attributed to the level of interaction between first suppliers and the OEMs in comparison to lower tier suppliers and the OEMs.

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Table of acronyms and abbreviations

APQP	Advance Product Quality Planning
AIAG	Automotive Industry Action Group
CBR	case-based reasoning
CCI	catalytic converter industry
COQ	cost of quality
CSRs	customer-specific requirements
IAOB	International Automotive Oversight Bureau
MWW	Mann-Whitney-Wilcoxon
OEMs	Original equipment manufacturers
QMS	quality management system
TQM	total quality management