

# SUPPLY CHAIN INTEGRATION IN NEW ZEALAND: BENCHMARK COMPARISONS WITH THE UK AUTOMOTIVE SECTOR

by

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## ABSTRACT

Supply chain integration is a promising approach to cross-enterprise process improvement that is still not well understood. This research investigates the level of sophistication (maturity) of supply chain integration in New Zealand from the systems uncertainty perspective. Uncertainty levels of value streams are evaluated using the 'uncertainty circle' concept, thereby enabling benchmark comparisons of value stream performance. A sample of 21 NZ process industry value streams is assessed using a so-called Quick Scan Audit Methodology (QSAM), and the uncertainty results compared with those obtained from 21 value streams in the UK automotive sector. This benchmarking revealed that value streams in New Zealand are weakly integrated and have control mechanisms which are significantly looser than those of the UK sample, even though they face higher uncertainty on the control and demand sides. In contrast, cross-country differences in supply and process uncertainty are marginal. While providing insights into the general health of New Zealand value streams, the authors acknowledge that the sample is not a comprehensive representation of every NZ value stream.

## KEYWORDS

Supply Chain Integration, Supply Chain Maturity, Benchmark Comparison, Supply Chain Practice, Supply Chain Audit

## INTRODUCTION

A supply chain can reasonably be described as a set of companies that eventually make products and services available to customers, with the ultimate goal to create value for end customers and for the organisations in the supply chain network (Christopher, 1998; Walters & Lancaster, 1999). To accomplish this, organisations in the supply chain must integrate process activities internally and with customers and suppliers externally (Lambert et al., 1998). Yet in most organisations the real situation might best be described as 'chaotic'.

This paper investigates supply chain integration sophistication (maturity) in New Zealand (NZ). A relative assessment of supply chain integration is achieved by comparing a sample of 21 NZ (predominantly large-scale) process industry value streams with a sample of 21 value streams in the UK automotive sector. Next a brief review of the relevant literature is presented before highlighting features of the methodological approach used. Finally, the findings are discussed, limitations highlighted, and future research avenues presented.

## LITERATURE REVIEW

Supply chain management, and in particular supply chain integration, originates from a systems perspective (Christopher, 1998) in which optimisation of the whole is held to achieve better performance than a string of optimised sub-systems. The argument is that integration enables trade-offs and wider ranging decisions to be made based on shared information and co-ordination (Frohlich & Westbrook, 2001; Lambert et al., 1998; Wong & Boon-itt, 2008). Given today's global trade effective supply chain management is important to every consumer, yet despite more than 20 years of

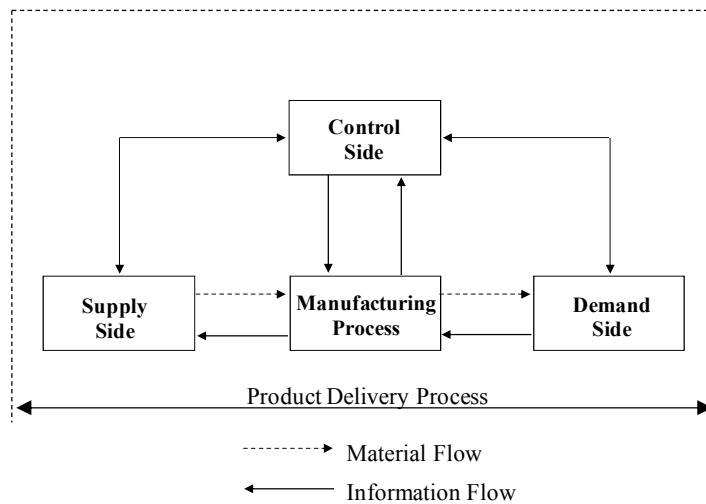
academic effort scholars continue to report that few companies are actually engaged in extensive supply chain integration practises and there remains a significant gap between supply chain theory and its practise (Akkermans et al., 1999; Kilpatrick & Factor, 2000; Towill et al., 2002).

Little is known about supply chain integration maturity in New Zealand (Böhme et al., 2009). Hence, this research compares supply chain integration maturity in New Zealand with earlier results obtained from the UK automotive industry (Towill et al., 2002).

The development of comparative measures of supply chain integration maturity is complicated by the wide variety of supply chains encountered in practise; the operational contexts within which they operate; and the complex multi-function, multi-organisation measures required. However, researchers have begun to use uncertainty for framing supply chain concepts, and as a comparative assessment measure, because this enables supply chains to be meaningfully compared irrespective of the context within which they operate (van der Vorst & Beulens, 2002; Vidal & Goetschalck, 2000; van Donk & van der Vaart, 2005; Wong & Boon-itt, 2008; Lee, 2002; van der Vorst et al., 2001 and Sun et al., 2009).

Both Davis (1993) and Mason-Jones and Towill (1998) segmented supply chain uncertainties into four areas which they termed the ‘uncertainty circle’, in order that root causes of problems can be identified and methods developed for minimisation (Childerhouse et al., 2007). The four areas of uncertainty are explained in considerable detail in Naim et al. (2002); similarly, the supply chain uncertainty circle (see Figure 1) has been successfully applied and validated (Childerhouse et al., 2007; Towill et al., 2002). Figure 1 indicates that in addition to uncertainty associated with the manufacturing process itself, a value chain faces uncertainty from the control, demand, and supply sides.

**FIGURE 1  
THE SUPPLY CHAIN UNCERTAINTY CIRCLE**



Source: (Davis, 1993; Mason-Jones & Towill, 1998)

### ASSESSMENT OF UNCERTAINTY

Supply chain integration maturity for this research was assessed using the so-called Quick Scan Audit Methodology (QSAM). This is a robust and valid research method that aims to achieve data triangulation and reduce researcher bias. The structured approach is designed to fit around the limited time available to busy managers, hence the QSAM process is typically undertaken by a team of four or five experienced researchers who are engaged for six days in total, of which three are on-site assisted by host organisation supply chain ‘players’. The QSAM audit methodology used in this research is explained in more detail in Böhme et al. (2008).

Supply chain maturity is quantified using the supply chain uncertainty circle of Figure 1. Qualitative and quantitative data relating to the various areas of uncertainty are used to assign the overall integration value by ranking each of the four areas of uncertainty. Codifying the four uncertainty sources is undertaken by all members of the Quick Scan team, to achieve researcher triangulation and a 4-point Likert scale is applied to each uncertainty area, with anchors of: 1=lowest uncertainty and 4=highest uncertainty. This reduces any tendency towards the mean and focuses instead on

strengths and weaknesses of individual value chains (Towill et al., 2002). Clearly a seamless value chain would exhibit low uncertainty scores for process, control, supply and demand.

In total, some 200 person-days were spent investigating 21 value streams in nine New Zealand process industry companies from four industry settings (forestry, dairy, manufacturing, food). The term ‘value stream’ was popularised by Womack and Jones (2005) and in many respects ‘supply chain’ and ‘value stream’ are synonymous. A practical interpretation is that a supply chain consists of a bundle of one or more value streams, hence a focal company can have multiple value streams. Next, the detailed uncertainty analysis for all four areas of uncertainty is presented.

## FINDINGS

Table 1 compares results from 21 NZ process industry value streams (data was collected between September 2003 and February 2008) with the Towill et al. (2002) data from the UK automotive sector (collected November 1997-February 1999). It can be seen that New Zealand's value streams are relatively poorly integrated, mostly due to having high levels of control uncertainty and demand uncertainty.

**TABLE 1  
COMPARISON OF NZ AND UK VALUE STREAMS**

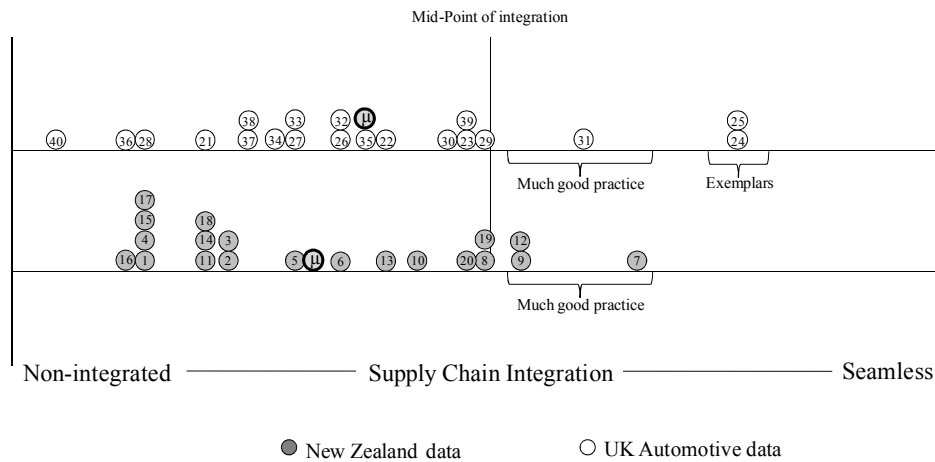
Uncertainty	NZ sample		UK sample		t-test	f-test
	Mean	Stdev	Mean	Stdev	p-value	p-value
Process	2.23	1.1863	2.30	1.0311	0.8092	0.2735
Control	3.35	0.6509	2.50	1.3179	0.0158*	0.0017*
Supply	2.70	0.9090	2.45	1.0990	0.4462	0.2078
Demand	3.08	0.9072	3.15	1.0400	0.8272	0.2787
Euclidean Norm	4.07	0.9951	3.78	1.4010	0.0103*	0.6034

\* Significant at  $p \leq 0.05$

Table 1 also compares the mean and standard deviation values of both samples. A t-test and f-test were used to determine whether significant differences exist between the means and standard deviations, respectively (significant at  $p \leq 0.05$ ). Several insights can be drawn from the comparisons. Firstly while the levels of demand uncertainty and process uncertainty in both samples is similar, the difference between the mean control uncertainty scores is relatively large, with the NZ uncertainty score being at a significantly higher value. The paired t-test indicates this difference is significant, confirming that New Zealand process industry companies have control mechanisms which are significantly looser than their UK counterparts. The f-test ( $p$ -value = 0.0017) also indicates that significant differences exist between both standard deviations (significant at  $p$ -value  $\leq 0.01$ ), which supports Closs and Mollenkopf (2004) who identified via quantitative comparison that companies in the USA place greater emphasis on internal integration (control and process uncertainty reduction) than do their Australian/New Zealand counterparts. The Euclidean Norm (square root of the sum of the absolute squares of its elements) was calculated for each value stream because ‘a chain is only as strong as its weakest link’. The Euclidean Norm mean value is significantly different between the two countries (significant at  $p \leq 0.05$ ) indicating that New Zealand companies on average face higher uncertainty than their UK counterparts.

Figure 2 presents the Euclidean Norm benchmarking comparison for the NZ and UK data sets.

**FIGURE 2**  
**BENCHMARK COMPARISON BETWEEN NZ AND UK AUTOMOTIVE**



Compared to the UK sample, approximately twice as many New Zealand value streams are within the non-integrated region of the chart - which also represents around 50 percent of the New Zealand value stream sample. Towill et al. (2002) concluded that some 80 percent of the value streams in the UK sample similarly faced high uncertainties and were therefore only weakly integrated.

A finding that is consistent across the data sets concerns value streams that have progressed beyond the 'Mid-Point of integration' in the figure. However, while Towill et al. (2002) identified two exemplar value streams within the UK data set, the New Zealand data revealed just three value streams that exhibited 'much good practise'. From this it may be concluded overall that value stream integration is poor in both countries and that high levels of integration are the exception rather than the rule.

## DISCUSSION

Development of comparative measures of supply chain integration maturity is complicated by the wide variety of supply chains encountered in practise. As a result, many researchers use subjective Likert scale measures (e.g. Rosenzweig et al., 2003) to assess respondents' perception of their supply chain. In contrast, this research applied a subjective 'uncertainty' measure to evaluate supply chain integration maturity in practise, which enables the researcher to benchmark supply chain performances irrespective of the operating context.

This research revealed that NZ process industry value streams are weakly integrated, and have significantly looser control mechanisms in place compared to the UK automotive industry - even though they face higher uncertainty on the control and demand sides. In contrast, values of supply and process uncertainty are similar. Control uncertainty is associated with information flow difficulties involving face-to-face communication and computerised information systems; meaning that such barriers exist at a socio-cultural level, a supply chain skills level, and a technology level. Basnet et al. (2003) similarly reported that New Zealand companies lack proper control mechanisms and often have outdated information systems. Likewise, Closs and Mollenkopf (2004) report that Australian and New Zealand companies place less emphasis on internal integration than do their US counterparts.

The poor uptake of supply chain integration concepts has been reported by others (Akkermans et al., 1999; Harps & Hansen, 2000; Kilpatrick & Factor, 2000; Poirier & Quinn, 2003; Towill et al., 2002) and, although some islands of good practise were detected, it is evident that a significant gap remains between the theory of value stream integration and its practise in New Zealand. This should sound a clear warning to New Zealand industry because not only was the UK automotive sector supply chain maturity found to be significantly higher, the base data was collected some 5-10 ten years earlier than the New Zealand study.

This exploratory investigation of the current state of supply chain integration in New Zealand has some obvious limitations. In particular, the sample size and makeup mean that the results obtained cannot readily be considered representative of the total population of New Zealand value streams, and the question remains whether other industry sectors are similarly weakly integrated. Mollenkopf and Dapiran (2005) for example report in their quantitative study that

world class supply chains do exist in Australia/New Zealand, hence further research is needed to more comprehensively explore the level and nature of supply chain integration within New Zealand companies.

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