Application of a Supply Chain Diagnostic to a New Zealand Manufacturer – A Case Study

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Abstract

This paper presents our experiences of performing a “Quick Scan” of supply chain operations at a New Zealand manufacturer. Quick Scan (QS) is a diagnostic methodology that examines the supply chain operations of a business organization, seeking to understand and document the business processes within logistics and production. This methodology, developed at Cardiff University in U.K., has been evaluated through numerous case studies in Europe (Naim et al., 2002). QS enables a health check to be carried out on a supply chain in order to identify and rank those areas in which improvements would yield most value. The overriding objective is to understand and document the supply chain by focusing on materials, information, cash and resource flows, initiating minimal on-line resources while at the same time achieving maximum scope (Berry et al., 1999). QS leads to the identification of Quick Hit (not Quick Fix) opportunities for improvement and longer term strategic action plans aimed at advancing the business process towards the seamless supply chain (Towill, 1997). QS is a diagnostic tool that can be used to provide recommendations about how to simplify and optimise business processes that require longer-term change projects and hence more resources.

1 Introduction

Quick Scan (QS) is a diagnostic methodology that examines the supply chain operations of a business organization, seeking to understand and document the business processes within logistics and production. This methodology, developed at Cardiff University in the U.K., has been evaluated through numerous case studies in Europe (Naim et al., 2002). QS enables a health check to be carried out on a supply chain in order to identify and rank those areas in which improvements would yield most value. The overriding objective is to understand and document the supply chain by focusing on materials, information, cash and resource flows, initiating minimal on-line resources while at the same time achieving maximum scope (Berry et al., 1999). QS leads to the identification of Quick Hit (not Quick Fix) opportunities for improvement and longer term strategic action plans aimed at advancing the business process towards the seamless supply chain (Towill, 1997). QS is a diagnostic tool that can be used to provide recommendations about how to simplify and optimise business processes that require longer-term change projects and hence more resources.
While the QS diagnostic methodology is extensively tested in Europe, it has not been implemented elsewhere. The goal of the research described herein is to evaluate the methodology in the New Zealand context and to refine it further. With this goal in mind, the supply chain operations of a make-to-order manufacturing business in New Zealand was investigated using the QS methodology. In this paper we describe this investigation and present some observations in regard to the methodology. The next section presents a review of diagnostic methodologies for supply chain practices, which is followed by a discussion of the QS diagnostic methodology. Then we present the New Zealand case application and its discussion. Finally, we present some concluding remarks.

2 Diagnostic Methodologies for Supply Chain Practices

In order to improve a supply chain and implement re-engineering programmes, current supply chain practices and performance must first be evaluated. Watson (1994) identifies four stages of successful business process re-engineering. Stage one is devoted to understanding the current situation, and once this has been achieved, stage two is concerned with documenting these findings. Stage three is process simplification, which is achieved via the identification of the most influential and critical factors. The final stage, optimisation, is then conducted in order to identify opportunities for improvement. This procedure is well known by the acronym UDSO. Hence, to re-engineer a supply chain its current practices must first be understood and documented. However, there are very few comprehensive methodologies available in the literature for understanding and documenting supply chains. One exception is Harland et al. (1993) who provide an excellent supply chain methodology. The methodology provides some clear insights into what factors should be measured and what techniques can be used to collect data. However, the methodology does not provide a comprehensive guide to evaluating a supply chain's current practices.

Christopher (1998) advocates the mapping of supply chain processes as a first step towards understanding the opportunities that exist for improvements in productivity through re-engineering those processes. Hughes et al. (1998) have developed ten questionnaires that can be used when auditing current supply chain practices in order to identify areas of potential improvement, thence to transform the supply chain and thus improve competitiveness. Four further alternative diagnostic methodologies are reviewed in Table 1. Although many of these techniques provide valuable insights into ways of evaluating current performance, none of them can be used as a stand-alone, systematic methodology for supply chain diagnostics.

All of the diagnostic methods to date have been tailored to deal with specific problem areas. What is needed is a generic approach that covers a wide range of supply chain issues within a short period of time. Further, the all important attitudinal issues need to be explicitly addressed when diagnosing supply chain performance. Due to the shortfalls inherent in alternative data collection techniques and the need for triangulation, a combination of data collection methods would provide the best means for understanding a supply chain’s current practices. This is the motivation for developing QS, which employs four data collection methods: interviews, questionnaires, process mapping and archival data collection. Triangulation of these four data collection methodologies should greatly increase the validity of all of the understanding gained. Any shortfalls in one of the methods would be compensated by the three other methods.
Table 1. Supply Chain Diagnostics Approaches (Source: Childerhouse et al., 1999)

<table>
<thead>
<tr>
<th>Diagnostic Methodology</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master Class sessions</td>
<td>The Society of Motor Manufacturers and Traders' Industry Forum Action Group (SMMT IFAG), holds Master Class sessions, in which experts from industry look at the technology and manufacturing processes adopted by a company. The sort of improvements that might typically be identified include SMED and process control.</td>
</tr>
<tr>
<td>Eindhoven University Quick Scan</td>
<td>The term Quick Scan was coined by researchers at Eindhoven University. It has a business process focus from the customer to the supplier, and concentrates on gathering indicators of performance and identifying bottlenecks. The approach consists of interviews, data mining from the particular company’s own information systems, an analysis stage and a feedback stage (Schaeffer, 1992).</td>
</tr>
<tr>
<td>Profit Pool Mapping</td>
<td>Developed as a technique to identify where the margin in a value chain is generated (Gadiesh et al., 1998). This allows opportunities for improvement to be identified by concentrating only on those activities that are adding profit and by outsourcing all of the others in order to exploit different cost structures.</td>
</tr>
<tr>
<td>Navigator</td>
<td>The Ernst and Young Navigator is a tool box approach with a best practice database, sample work sheets and an implementation methodology (Towill, 1999).</td>
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3 Overview of the Quick Scan Diagnostic Methodology

The QS process, illustrated in Figure 1, is designed to be completed in just two weeks once the first two stages (identifying a suitable supply chain and obtaining buy-in from a business champion) have been accomplished. During these two weeks only three days are stipulated to be spent on site, thus minimising any disruption to the organisation being Quick Scanned. In order to ensure that this short time scale can be accommodated, the QS team normally consists of four researchers and a business champion.

On average each individual QS takes 25 person days to complete, ten of which are spent on site. This time spent within the client organisation is very intensive while the four dominant sources of data are collected. This is achieved through presentations (1 person day), investigative methods (3 person days), collecting and evaluating written documentation (2 person days), numerical techniques (2 person days) and people contact (2 person days). Following is an explanation of the activities conducted during the four main steps of the QS.

3.1 Preliminary presentation

The preliminary presentation explains the QS methodology to everybody involved and highlights the specific objectives for their business process. Representative products are then selected for in-depth analysis. An interview plan is developed and questionnaires are issued to those personnel to whom the exercise is most relevant.
3.2 Conducting the QS using four data collection techniques

The QS diagnostic is based on four types of data: attitudinal and quantitative questionnaires, process maps, structured interviews, and archival information. A total of eleven qualitative, attitudinal questionnaires are completed during a QS. The second data collection format is process mapping. This is the most important source of information as it provides a detailed understanding of the material and information flows for each value stream. The third type of data collected during the QS comes from structured interviews conducted with a cross-section of the senior and middle management from all departments in the company. The final type of data collected during the QS is archival. This is segmented into four parts. The generic Uncertainty Circle model (Mason-Jones & Towill, 1998) is then used to identify which of the demand, supply, control or process areas will require the greatest re-engineering focus.
Particular attention is paid to understanding and documenting these four areas of uncertainty.

The first day spent on site involves the collection of these four standard types of data and culminates in a brainstorming session designed to evaluate further avenues of investigation. This leads to a more focused approach on the second day in order to validate and further investigate key issues.

3.3 Analysing the findings

Triangulation of the different forms of information described results in the achievement of a balanced perspective, where no single viewpoint swamps any other. A large number of analytical tools is utilised at this stage of the QS process, but these will need to be chosen according to their applicability, for example, cause and effect analyses, Pareto analyses, application of a best practice database, and financial performance rankings. The first step is to agree on an outline of the supply chain under analysis and the major business processes utilised. This usually involves developing a supply chain map agreed upon by the QS team. It is important that everyone be given a chance to contribute, so as to ensure that the potential bias of any individual players is kept to a minimum.

An initial brainstorming session is conducted in order to identify and document as many different first impressions as possible. It is important not to question the validity of any suggestions put forward at this stage, but to keep the impressions coming, whether good or bad. The next stage is to quantify and justify these first impressions. For example, if scrap levels were perceived to be high, the actual scrap rate of the various operations in the business process ought to be identified. If stock levels were perceived to be particularly high, a time series on the stock level should show the dynamics of this issue. In order to validate these first impressions it may be necessary to collect additional data on specific issues that have arisen following the initial site visit.

The next stage is to identify the key business cost drivers. This is achieved using the quantified first impressions and via utilisation of the economic value added (EVA) formula. For example, a heat treatment company’s profit will be predominantly determined from how much of its furnaces’ capacity is utilised. From these early stages of analysis the major pain is identified. This then becomes the focus of further analysis leading to the construction of a suitable diagram that illustrates the factors that contribute to this major pain. From the diagram, the significant root causes of the various areas of pain are identified. It may well be that some of the bad impressions that were identified earlier lie at the root of the pain. They may also, however, have been identified in the structured interviews or in the questionnaires.

The penultimate analysis stage is the identification of opportunities for improvement. Careful consideration is given to quantifying the EVA benefits that will be gained by taking specific actions. Thought is also given to the likely “cost of implementation” and to the time that it would take to implement each improvement activity. Finally, each improvement opportunity is evaluated in relation to its cost, time to implement and benefits, therefore providing rankings for each feasible opportunity for improvement. The findings of the analysis stage are then summarised in a short list of validated and prioritised opportunities for improvement in the short, medium and long terms.
3.4 Feedback presentation

A critical phase of the QS diagnostic is the final feedback presentation to the management of the client organisation, during which the opportunities for improvement are discussed, problems with any of the solutions are identified, and future action plans are agreed. It is also necessary to outline the resources that will be required to initiate the actions and to decide whether any further involvement will be required from the QS team.

4 A New Zealand Case

We turn our attention now to an application of the QS methodology to a New Zealand organisation. We report on the outcome of a QS diagnostic carried out on the operations of New Zealand Fabricators (NZF), a make-to-order engineering company in August-September of 2003 (some details have been changed in order to mask the identity of the client organisation). The goal of this project was to test the diagnostic methodology in the New Zealand context, as mentioned before, and to train our team at the University of Waikato on the methodology. NZF is a major engineering company that fabricates structures to order. These structures have been manufactured traditionally to order, but lately management has been switching the manufacturing strategy from make-to-order to assemble-to-order. The idea is to fabricate basic common parts in advance of orders, to a forecast. This is a delayed differentiation strategy that should permit lower inventory buffers, and smoothen the manufacturing ups and downs.

The first step was an initial meeting with the management where a sponsorship for the project was sought, at no cost to the company. The operations manager of the concerned division agreed to champion the diagnostic project in the division. Early in August 2003, a team from University of Waikato visited the plant to prepare the ground for the audit (preliminary presentation). The entire methodology was explained to the concerned people, and duties were assigned. After two weeks a team of five researchers visited the plant. The five researchers were assigned the four tasks mentioned above: gathering archival data, getting detailed questionnaire filled by concerned people, tracing process steps, and interviewing key people. At the end of the first day of data gathering, the diagnostic team had a brainstorming meeting where preliminary ideas about the “pains” faced by NZF were thrashed around. As a result of this, more focused data was gathered on the next day to confirm/refute the hypotheses postulated at the meeting. Upon return to the University at Waikato, the group analysed the data gathered and went back to the plant a week later to present the findings to the concerned people at the plant, including the champion for the project. The findings of the group are summarised in the next few sections.

4.1 Positives

NZF has a strong market dominance in the products it offers to the customers. They are able to come up with innovative new products with good market potential. NZF have procured from over 100 suppliers for years: this provides a good network for their outsourcing activities. Annual contracts are signed to ensure a competitive price. Over the years trust has been built between NZF and its strategic suppliers. Suppliers are very responsive, meeting delivery targets to NZF on time. NZF has a noticeably friendly working atmosphere with good internal relationships and without process barriers. NZF has long experience and strong expertise in its area of work. The customers are well-served by NZF. Project supervisors maintain close contact with their customers. The
projects are delivered on-time, or if they are late there is a justification good enough to satisfy the customer (usually any delay can be blamed on customer-requested changes).

4.2 Negatives

NZF has an antiquated information system, which is primarily an accounting tool for procurement and stock-holding control. It does not have functionalities needed for a modern production/logistics operation. There are informal, undocumented information systems across divisional areas in the form of spreadsheets and databases. Procurement staff have to rely on their tacit procurement knowledge for ordering. Internal communication is suffering on account of the inadequate information systems. The information system provides reports on cost-related key performance indicators (KPI) only. Supply costs, labour costs, inventory costs, and project cost variances are monitored and reported. However, information on other aspects of performance, namely schedule adherence and quality adherence, needs to be collected and monitored.

Quality problems abound in the form of scrap and rework. Much of this is not seen by management because it is not documented. Luckily, quality defects are detected before they reach the customer; therefore this is not a source of customer dissatisfaction.

The process layout for the plant is inefficient and complex. Figure 2, below, depicts an approximation of the product routing at the plant. In line with the inefficient shop floor layout, there are no or few dedicated locations for semi-finished/part fabricated parts. The shop floor and surrounding yards are untidy and contain a mix of scrap, raw material, junk, and semi-finished components. This gives an impression of an unprofessional workplace and must result in difficulties when locating semi-finished parts.

![Figure 2. Production Flow at NZF](image)

Historically the work at NZF has been conducted on a project basis. The move towards assemble-to-order strategy is not complete. All the planning and control systems are still geared towards project management; and the culture of the company is project-oriented. Some units in NZF have understood assemble-to-order to mean production of WIP to utilise idle people or equipment. WIP has been produced just to
keep people or equipment busy – WIP exists for 3 months or more of production; some component stocks are enough to cover 12 months of production.

4.3 Root causes

Figure 3 shows the cause and effect diagram for the root causes behind the problems faced by NZF. Scrap and rework directly lead to waste. This is contributed by lack of quality oriented performance measures and staff training issues. Staff time is wasted by the informal information systems consisting of spreadsheets and databases, which entails duplication of effort and possible sources of error. This stems from the poor and outdated information systems at NZF. The information system also contributes to lack of good communications in the organization. Excessive inventory is another source of waste. Lack of a scientific inventory information system means the use of a “seat of the pants” approach to procurement, leading to higher buffer stocks than necessary. Cost-driven KPI’s also focus on utilization of labour and equipments, thus building up unnecessary inventory.

Figure 3. Cause and Effect Diagram for the Root Cause

4.4 Recommendations

From the above analysis, we made recommendations to NZF with a view to improve their logistical operations. Some of the main recommendations are listed below.

- **Information systems.** NZF needs to implement new ERP systems that would integrate the entire enterprise as well as the supply chain. ERP systems typically have many modules, each covering different functions within a company such as finance, logistics, manufacturing, order fulfilment, human resources and supplier management, etc. The functionality of Gantt chart based project management can also be plugged in to ERP. This is a very time and resource consuming IT project with commensurate pay-off.

- **Procurement.** Formal procurement practices need to be implemented: raw material stock levels should be based on production requirements. Considering
the excellent supplier relationships and lead times, it is hard to justify the excessive raw material stocks.

- **Production planning and control.** Formal production planning and control needs to be instituted. This could be in the form of master production scheduling / material requirement planning or just-in-time kanban controls.

- **Shop floor layout and housekeeping.** The process flow needs to be reengineered and streamlined. Dedicated stocking points need to be established for all WIP. Good housekeeping should be instituted for shop floor and yards.

- **Key performance indicators.** The shop floor should formally measure and report the rework time and scrap rates, and try to improve them continuously. It is important to display the results prominently. Good benefits can be obtained from minimal use of resources here. Similarly inventory performance, production performance, and supplier performance need to be measured and monitored. Medium benefits can be had here for small resource inputs.

### 4.5 Feedback to the client organisation

The client organisation accepted most of our analysis and recommendations, particularly in regard to the shop floor layout, information systems, communications, and procurement. However they did not agree with our observations regarding excess inventory; they felt that the problem was not systemic, but was a one-off phenomenon caused by particular events at the time of the investigation.

### 5 Discussion

In this section we present our observations on the QS diagnostic methodology. All members of the team except one were new to the task. The goal of the investigation was training of the team as well as the evaluation of the methodology. Thus our observations may be influenced somewhat by the novelty of the methodology to us.

The QS methodology is designed to minimise the use of resources and the disruption at the client organisation. The QS team spends only two rather intense days at the organisation gathering data. Any forming of hypotheses regarding the issues at the organisation, and gathering of information to refute/confirm the hypotheses is done on the fly. A single evening is assigned to brainstorming by the team. Our team struggled with the tightness of this schedule. In the future we plan to carry out this process in two stages: a preliminary general collection of data on site using all the four data collection techniques on the first day. This will be followed by a day of analysis, brainstorming, and discussion about the issues and the root causes behind these issues. This will be carried out away from the site, and essentially would consist of hypothesis generation. In the next stage, a day will be spent on site, gathering data in a more focussed manner with a view to test the hypotheses.

Our team also struggled to collect archival data from the client organisation. Most of this was non-existent because the requisite data was not gathered and stored by the outdated information system. We suspect this is a common malaise in New Zealand. It appears that this type of data can be collected only through intensive efforts at chasing paper trails and would be more time consuming than envisaged by the QS designers. One solution would be to ask the client organisation to assign people to gather specific data, in advance of the visit of the QS team.

Another issue in data collection, which is much less severe, is with the interviews. Many interviewees were not very comfortable with the interview technique and were
not forthcoming. Some confidence-building measure, such as a meeting in a social setting, should alleviate this concern.

6 Conclusion

In this paper we reported on a New Zealand case study of a supply chain diagnostic methodology called “Quick Scan”, which is a well documented methodology developed in Europe. The diagnostic enabled us to analyse the supply chain operations of the case organisation and to make recommendations that were accepted by the organisation. However the investigation pointed to the need of some fine-tuning of the methodology, particularly in regard to the time-frame of two days allowed for on-site data collection. We felt that one extra day needs to be interleaved between the two days to allow for analysis, brainstorming, and discussion.

More quick scans are planned to further validate and refine the methodology.

Acknowledgments

We wish to express thanks to student members of the team: Ma Weizheng, Luo Yi, and Zhao Xiaodan. We also acknowledge the efforts and cooperation of the team at the client organisation.

References


