INTERNATIONALISING THE QUICK SCAN AUDIT METHODOLOGY

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Abstract

The **Q**uick **S**can **A**udit **M**ethodology (QSAM) is a supply chain business diagnostic. The QSAM has both an Action Learning and a Management Theory stream. The former is concerned with evaluating the operating characteristics and performance of specific value streams. The latter builds on codified data emanating from a sample of QSAM outputs to statistically evaluate any possible contributions to new management theory. During such research other powerful outputs including delineation of best practice and identification of preferred, successful, trajectories for change emerge. Originally developed to suit research needs when studying European Automotive First Tier Suppliers it was also tested on other European value streams. Recent opportunities have arisen to apply QSAM more widely. To date the major contribution from QSAM studies on other continents is restricted to the action learning mode by minimum sample size considerations. The latter will be satisfied in due course. This paper presents the background and *modus operandi* of the QSAM plus new action learning lessons arising from internationalising the supply chain diagnostic.

Key Words: Supply Chains; Audit Methodologies: Best Practice, New Management Theory; Benchmarking

1 INTRODUCTION

Christopher [1] strongly advocates the mapping of supply chain processes as a first step towards understanding the opportunities that exist for improvements in productivity through subsequent re-engineering. Hughes *et al.* [2] 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 to improve competitiveness. Four further alternative diagnostic methodologies are reviewed in Table 1 together with **Q**uick **S**can **A**udit **M**ethodology (QSAM). Although many of the earlier 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. Hence our development of QSAM [3].

In our experience what is needed is a generic approach that covers a wide range of supply chain issues within a short period of time. Furthermore, 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 such methods would provide the best means for understanding a supply chain's current practices. This is the motivation for developing QSAM, which employs four data collection methods: interviews, questionnaires, process mapping and archival data collection. Triangulation of these four techniques 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.

QSAM is an approach to operations management research posited as a knowledge acquisition process complementary to Horizontal Postal Surveys (HPS) and Vertical Case Studies (VCS). QSAM offers a rich picture output from a team based approach involving internal and external auditors. The core objective of QSAM is the measurement of the uncertainty vector as a key performance metric. Internationalising the diagnostic requires that the internal validity, external validity, reliability, and objective criteria be simultaneously met. The paper establishes that QSAM is a robust methodology which copes with changes in personnel, culture, and market sector. It is concerned with experiences applying QSAM beyond the automotive market sector in which it was first exploited.

2 QUICK SCAN AUDIT METHODOLOGY

***Q**uick **S**can **A**udit **M**ethodology (QSAM) is a powerful methodology originally developed to establish the health of an individual supply chain, and by creating a set of unified and codified performance attributes can evaluate the distribution of the effectiveness properties of a sample of competing value chains.* Statistical analysis of these results can then identify supply chains located at various positions within this distribution. Those clustering around the mode (or around a trend line) can then be examined in depth to confirm that observed operational characteristics are indeed similar and thus help to define typical behaviour. Detailed investigations of any outliers can pinpoint the reasons for best practice and poor practice respectively. The former ranked i.e. top value streams can then be generically exploited by transferring known and proven principles to supply chains in both cognate and often other market sectors [4].

However, in conducting such research in the real-world, where actual supply chains rather than simulation models are audited, it is expected that academics will offer back some immediate output to compensate host companies for using their material flow scenarios as a live laboratory. This requirement is met by identifying Quick Hits as a definite output from QSAM. This activity covers the most

Table 1: Supply Chain Diagnostics Approaches

Diagnostic Methodology	Brief Summary
Master Class Sessions	The Society of Motor Manufacturers and Traders' Industry Forum Action Group holds Master Class sessions, in which experts from industry review company technology and manufacturing processes. Typical improvements identified might typically be include SMED and process control
Eindhoven University Quick Scan	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 establishing indicators of performance and identifying bottlenecks [5].
Profit Pool Mapping	Developed as a technique to identify where the margin in a value chain is generated. Concentrates on those activities that are adding profit and by outsourcing all others in order to exploit different cost structures [6].
Navigator	The Ernst and Young Navigator is a tool box approach with a best practice database, sample work sheets and an implementation methodology [7].
QSAM	Extends the Eindhoven approach based on material flow but an Action Learning activity is performed on site followed by generic research, including statistical analysis and identification of, and evidence for, best practice.

obvious improvements which for a relatively small expenditure of effort, time, and money, produce significant improvements in performance. Rapid implementation and successful operation add credibility to the reputation of the academics as being both rigorous and knowledgeable in dealing with real-world problems.

Such enhanced creditability can then greatly help accelerate the spread of QSAM throughout the desirable value stream sample. However, in many supply chains QSAM will also identify major and hence resource-consuming changes which will have to be undertaken if the enterprise is to remain competitive. Hence a further QSAM output is a shopping list of needed improvements which will be at the core of the BPR Programme. In fact the re-engineering brief can be written on the basis of the QSAM report. As shown in Table 2, this is part of the Action Learning activity in QSAM.

There is a further, extremely important use of QSAM results. This is to establish new and credible management theory and is also included in Table 2. Such an innovative procedure also relies extensively on the codified outputs profiling each value stream. The validity of the codification systems will have already been established via the clustering and best/poor practice analysis. Hence this data can be used to establish the significance or otherwise of other factors thought to influence the performance of individual value streams.
One such major thrust within the QSAM is the desirable objective of enabling smooth material flow. To assist the BPR activity, a set of 12 design rules have been proposed, based on detailed studies of successful

Table 2: QSAM ~ *Modus Operandi* and Activity Outputs

Modus Operandi	Commitment Activity
Action Learning Mode	Perform Quick Scan on Site
	Establish QSAM Knowledge Base
	Outline Quick Hits
	Write BPR Programme Brief
Generic Research Mode	Codify QSAM Outputs
	Evaluate Value Stream Models
	Identify Best Practice
	Establish General Management Theory

projects and the associated literature. QSAM has enabled these rules to be statistically tested, their contribution to streamlined flow identified, and the degree of usage across the value stream sample assessed [8, 4]. Here the eventual output is the availability of a tried and tested Tool Kit for delivering smooth material flow. In particular, because we now know that the Tool Kit works well within the sample enterprises, we can have added confidence in its transferability to other organisations.

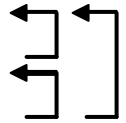
3 ACTION LEARNING IN QSAM

The QSAM process, as summarised in Table 3 [3], is designed to be completed within a two week time window. This follows after 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 very intensive days are expected to be spent on site by the audit team, thus minimising any disruption to the organisation being Quick Scanned. In order to ensure that this short time scale can be accommodated, the QSAM team normally consists of a core of four researchers and a business champion. However it is essential that this team is representative of the business process under study. Hence additional internal members are also seconded thereto. Otherwise it is difficult to properly map the relevant material and information flows with sufficient confidence.

On average each individual QSAM takes 25 person days to complete, ten of which are spent on site. Thus QSAM is a very focused action learning activity. So time spent within the client organisation is very intensive while the four dominant sources of data are collected. This is achieved through presentations, investigative methods, collecting and evaluating written documentation,

Table 3: Action Learning Activities Within QSAM

Step No	Activity
1	Identify Candidate Supply Chain
2	Get Buy-In from "Product Champion"
3	Set Up Fully Representative Audit Team
4	Preliminary Presentation on Site
5	Determine Specific QSAM Strategy
6	Conduct Quick Scan on Site(s)
7	Analyse QSAM Findings
8	Feedback Presentation on Site
9	Write QSAM Report



numerical techniques and people contact. In Table 3 we have allowed for two internal QSAM loops. It is frequently found during data analysis that further acquisitions are necessary, which might be sourced both inside and outside the delivery process. Occasionally there may be a need to modify the particular QSAM strategy as the study proceeds. Thus QSAM operates very much in hot pursuit mode.

4 QSAM AS A CONTRIBUTOR TO NEW MANAGEMENT THEORY

As an illustration of the exploitation of QSAM as a route whereby new management theory is established we consider the case of enabling smooth material flow via use of an appropriate tool kit [9]. This is but one example of the power of the methodology in assessing the effectiveness of supply chain design tools. A fundamental part of this aspect of QSAM to date has been the concept of the uncertainty circle. This is based on assessing the uncertainty of four discrete points linking up with system interfaces. Hence the sources are Our Process: Supply Side: Demand Side: and Control Side. By coding these uncertainties on a four point Likert scale by reference to specific observed phenomena, every supply chain in a QSAM sample may be allocated a score. It has already been shown elsewhere [9] that such scores are reliable indicators of bottom-line performance in real-world scenarios.

However, reference to Table 4 shows how statistical analysis can be used to determine the relative value of the twelve proposed smooth material flow rules [7]. The objective is to establish which (if any) such rules can be regarded as the most useful to help guarantee good performance. For this purpose the usage of the particular rule is correlated with the reduction in uncertainty. For individual value streams the four uncertainty scores are reduced to a single metric via the Euclidean norm. In Table 4 the resultant statistical analysis shows that for this 40 value stream sample, four rules are highly statistically significant (three others are significant but at a lower level). Hence when re-engineering a value stream there is strong statistical evidence supporting the exploitation of these rules in the BPR programmes. Further research in this area has also established that specific smooth material flow rules should be prioritised according to product type [9].

Table 4: Contribution of QSAM to Management Theory: Ranked Correlations Between Each of the 12 Simplicity Rules and the Euclidean Norm Uncertainty Scores Across a 40 Value Stream Sample [9]

Rule No	Smooth Material Flow Rule Description	Significance
12	The operational target is to enable the Seamless Supply Chain i.e. all players think and act as one	**High** (at 99% level and above)
8	Eliminate all uncertainties in all processes	
3	Streamline material flow and minimise throughput time i.e. compress all lead times	
4	Use the shortest planning period, i.e. the smallest run quantity which can be managed efficiently	
10	Streamline and make highly visible all information flows throughout the chain	**Moderate** (at 90% level and above)
9	Understand, document, simplify and only then optimise (UDSO) the supply chain	
6	Synchronise time buckets throughout the supply chain	
7	Form natural clusters of products and design processes appropriate to each value stream	**None** (for this QSAM sample
1	Only make products which can be quickly dispatched and invoiced to customers	
2	Only make in one time bucket those components needed for assembly in the next period	
11	Use only proven, simple but robust Decision Support Systems	
5	Only take deliveries from suppliers in small batches as an when needed for processing or assembly	

5 MOVING QSAM INTO THE PROCESSING SECTOR

The target company identified for the application of QSAM was one of New Zealand's major dairy processors. The major process steps are illustrated in Figure 1. They are primarily the collection and processing of milk into butter and milk powders. These are predominantly destined for overseas commodity markets. This type of continuous process is commonplace in NZ. It thus provides another avenue for testing the QSAM on a very different, non-discrete production oriented supply chain. Hence the commonalities and the differences between dairy produce and automobile supply pipelines should become readily apparent after the QSAM.

Figure 1 shows the aggregate process map. Assessment of various flows cross interfaces are key to system modelling and understanding [11]. The main pain identified during the QSAM was the very poor misalignment of production and sales. Four root causes were to blame for this state of affairs as follows:

- Poor internal communication resulted in limited understanding of alternative functions, objectives, and issues.
- Functional silos resulted in conflict between production and sales.
- Dairy production is heavily seasonal, with supply of milk peaking in spring. During this period the dairy processor was capacity constrained and could only produce basic products in large batches. This rarely matched with demand.
- Lack of strategic procurement function; every middle manager was separately managing their own purchasing. This was often performed indifferently and in ad-hoc mode so raw materials essential for specific product optimisation of the whole supply chain were often not available. There was also a lack of sales data in the supply chain.

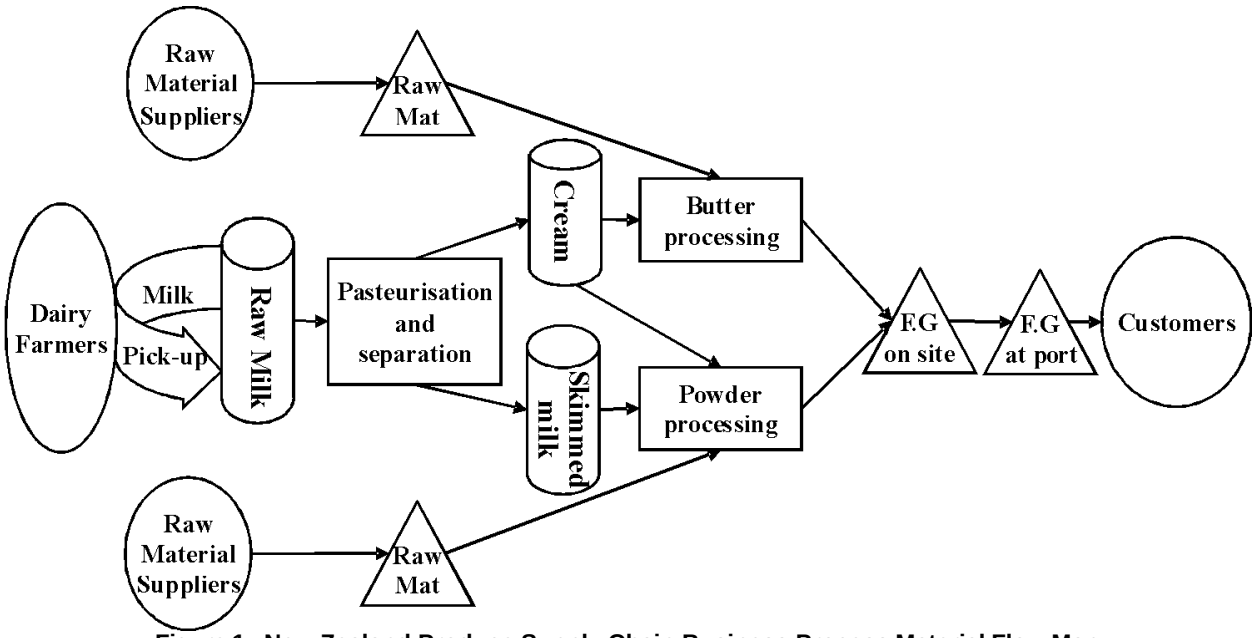


Figure 1: New Zealand Produce Supply Chain Business Process Material Flow Map

Much of the foregoing is typical of problems frequently met in the semi conductor industry, where supply met demand about once in every 10 years [12].

Of the improvement opportunities afforded, the industrial partner focussed on resolving the root causes and not just relieving problems in the short term. The QSAM recommended the implementation of modern IT to enhance communication and alignment, training to overcome functional bias and strategic approaches to matching supply and demand. The standard QSAM methodology was modified by the splitting of the data gathering into two parts separated by a day to give an opportunity to reflect and develop hypotheses facilitating the focussed collection of validatory evidence. This was particularly useful during the feedback presentation and enabled proof to be offered to aid understanding during the, sometimes, heated discussion between the industrialists. Furthermore, the modified methodology was more detailed and prescriptive for those members training in the QSAM method. The continuous flow nature of the dairy processor was relatively easily handled by the methodology. What was more unusual for the QSAM team was identifying the combination of pressures due to both supply and demand uncertainty. This is partially explained by the high seasonality of the agricultural sector.

6 QSAM STUDY OF THAI SOYBEAN OIL CO

The Thai Soybean Oil Company, subjected to a QSAM study, is also a traditional process market sector supply chain. Action is initiated when the Purchasing Department contacted raw material suppliers to deliver raw material into the processing line according to the plan faxed to the supplier. The Production Department then prepares the line accordingly. The soybean oil production commences but whilst sending the raw material into the processing line, suppliers will concurrently bill the order to the Soybean Accounting Department. The production will be complete when the extracted soybean oil is poured into the containers. This may be in the form of individual bottles or by the gallon depending on the customer requirement. These containers will be transferred to the warehouse for labelling and packaging into cartons. The Quality Control Department then test the finished product, and check the accuracy of the labelling. If there is a problem with the sample, Quality Control will inform the Warehouse and Production to hold it back for rechecking. When/if the result is satisfactory this batch is released. The freight forwarder is then notified to pick up the products and distribute to the customers. It was also observed during the QSAM that the flow of information is reflected the previously described material flow.

The production processes were established by the QSAM to be operating relatively efficiently. Non-value added time was only 22% of total manufacturing time. This should be compared with the typical 97-98% experienced in discrete production of mechanical components. Nevertheless a number of important weaknesses were identified via QSAM as follows:

- Supplier Relationship Management needed a much higher profile
- Some of Soybean Co's core skills needed to be transferred to suppliers
- Demand planning was relatively poor
- Better demand planning would reduce inventory costs
- Better demand planning would reduce lost sales resulting from raw materials shortages
- Greater flexibility was needed at all operational levels

Companies in the soybean oil industry are always faced with the problem of demand fluctuation. It is a consumer product, but demand is dependent according to advertising, marketing campaign, and new product releases into the marketplace. Forecast accuracy is typically limited to 65% within this industry. The QSAM established there are records available related to production, inventory and sales but these records are not exploited to forecast consumption. At the moment the Planning Department acting in isolation would make the production plan by following the customer's order issued from the Marketing Department. But the Marketing and Planning Department should also participate in the weekly scheduling meetings in order to share this information. In

determining the production plan, managers would only consider the capacity in the processing line. If it was adequate to manufacture the new order then confirmation was just sent to the Engineering Department indicating that the machines were ready to run.

If all the related departments participate in the weekly meeting it is argued that the demand forecasting should be more accurate via sharing not only data but market feedback. This suggestion is hardly rocket science. It does, however, justifyingly move into rocket engineering thought processes if simulation software is used as an aid to answering inevitable 'what if' questions raised at scheduling meetings. Experience of the UK pharmaceutical industry suggests that *much* better forecasting is made under such a multi disciplined approach [13]. This procedure also helps to remove barriers put up defending the interests of functional silos by providing contrary evidence from a position of strength. The BPR programme enabling that change was enlightenly called 'From Arbitration to Agility'. Hence here is an obvious opportunity to transfer best practice identified via QSAM and across international borders.

7 DISCUSSION ON QSAM INTERNATIONAL EXPERIENCE

A brief summary of internationalising QSAM experiences is shown in Table 5. Where some opposition has been met to QSAM this has been the result of fear of the audit and/or consequential change. Also analytical tools are of restricted use when dealing with companies with little in the way of archival data. No problems have been encountered in translating QSAM requirement into other languages. Of the four core data collection techniques applied within QSAM, the psychometric questionnaires are presently considered the weakest. It is likely that further research will lead to modification tailored to specific market sectors. When the main value-added process does not involve assembly-type operations, restructuring of questionnaires is especially necessary to identify non-material flow related customer and supplier interface problems.

In Thailand there is emphasis on family run businesses with strong leaders. NZ in contrast can have a *laissez-faire* business attitude which naturally opposes change. The powerful QSAM output of identification of real-world best practice has led to transference elsewhere. However the further exploitation of statistical modelling leading to new management theory awaits further cross-industry validation, especially comparisons based on uncertainty scores. Most QSAM outside Europe has involved only well-established technology and production processes. This has obviously restricted certain sample sizes. Whereas QSAM has worked extremely well (and relatively smoothly) in the automotive sector, it has generally been more difficult to apply in the service sector. In such cases the tacit knowledge of QSAM team members has helped overcome shortfalls in archival data.

Within the European automotive sectors there are similar but complex material flows, plus common power structures and organisational cultures. Statistical modelling has therefore been highly successful. But in European non-automotive value streams there is a diverse set of organisations, products, and material flows. This requires a very large sample before significant similarities can be confidently identified. NZ has problems with long lead times (sea transport), individualistic and pioneering attitudes, and a significant exchange rate influence. The Thai QSAM's have exposed major differences between family run business and those with foreign shareholders. Within these groupings value stream behaviour has so far been observed to be similar.

8 CONCLUSIONS

Supply chain auditing is a time-consuming but essential task. Application of QSAM can lead to consistency of assessment, identification of quick hits, highlighting of best practice, and deduction of new management theory. QSAM seeks to ensure that the audit process is both cost and time effective. It is enabled via a structured approach, hands-on researcher training and a team format which includes industrial partners capable of studying both individual tasks and business interfaces. So far as possible, the output from QSAM is an unbiased rich picture of any particular value stream. Such outputs can then be codified to enable both signature and statistical comparisons to be offered up. It is this aspect which supports emergent paradigms by establishing that improved performance does not come about just by chance.

But does QSAM travel well in the sense of providing a reliable Action Learning context outside of the relatively narrow First Tier Automotive Supplier market sector for which it was initially developed? Initial results from both Thailand and NZ indicate that this is so far the case. However there are cultural differences which affect detailed application. Thailand is blessed with a plethora of family-based businesses led by strong entrepreneurs. This contrasts with a rather laid-back approach of many NZ companies. Although NZ suffers from long transportation time delays within its supply chains, it may be argued that this also acts as a psychological buffer away from the day-to-day frenzy typical of (say) the European automotive sector. Hence at this stage it is strongly anticipated that as international experience with QSAM accumulate, tailored approaches will evolve based on non-material flows, and on the specifics of process industries.

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Table 5: Initial Geographical Comparisons of QSAM Properties

Attribute	Europe		Elsewhere	
	Automotive	**Non-Automotive**	**Thailand**	**New Zealand**
Are barriers to QSAM application readily overcome?	Low to Medium	Low to Medium	Medium	Medium
Are the analytical tools relevant?	High	High	High	Medium
How transferable is QSAM?	High	High	High	High
Are changes required to the psychometric questionnaires?	Medium	High	High	High
Specific differences in value stream behaviour between countries	Relatively homogeneous	Small but depends on sector	High	Medium
Can results be meaningfully compared?	Yes	Partially	Partially	Partially
Impact of product type	Low to Medium	Medium	Low to Medium	Low to Medium
Impact of technological differences	Low	Low to Medium	Medium	Medium
Are service companies different?	QSAM satisfactory	QSAM requires modification	QSAM requires re-vamp	QSAM requires modification