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THE DEVELOPMENT OF A SUPPLIER PERFORMANCE EVALUATION TOOL

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Abstract: As product life cycles continue to shrink and global competition increases, manufacturers are outsourcing what they consider to be non-strategic activities in order to focus on their core competencies. Consequently these organisations must rely more and more on their external contractors and suppliers to support all non-core activities. Progressive organisations are therefore developing proactive supplier based strategies in order to integrate these suppliers in to their processes and systems. To do this, they must focus on the critical few. In other words, they must identify best performing suppliers and eliminate those that do not add value. This paper presents a case study of a large multinational organisation in its quest to rationalise its supplier base and reduce inventory costs. To do this suitable performance metrics including one appropriate for Just in Time (JIT) suppliers were derived. A computer based measurement tool was then developed to collect the appropriate data and perform the evaluations. This resulted in an impressive 2.9 fold reduction in the numbers of suppliers from 23,225 to 8,024 and a 2.6 fold reduction in the value of inventory held from $15.24 million to just over $5.86 million. Findings from this case analysis are presented.

Keywords: Supply Chain Management, Extended Enterprise, Performance measurement, Case Study.

1. Introduction

There are ever-increasing demands from customers for more manufacturing agility in the form of higher product variety, smaller production runs of more customised products and batch sizes with shorter delivery times (Voss, 2003; Walters & Buchanan, 2001). To meet these requirements, manufacturing must have rapid access to the required material. This can be achieved by managing the supplier base and creating shorter and more responsive materials supply chains. Consequently, manufacturing organisations are now considering suppliers to be virtual extensions of their factories (Cousineau, Lauer, & Peacock, 2004; Kemppainen &Vepsäläinen, 2003; Branganza, 2002; Browne & Zhang, 1999). In order to facilitate this, processes and systems must be developed to help identify preferred suppliers with which a company can develop closer relationships and enable them to be integrated more into the organisation's materials supply chain. Such integration allows suppliers to better plan their own production and it gives them forewarning of changes in the manufacturing organisation's plans. It also enables them to shorten their manufacturing lead times and coordinate their deliveries of materials with other suppliers in the supply chain, so that the required materials arrive at the manufacturing site on time to meet production requirements and fill customers' orders. This improves the quality of service provided by the suppliers (Cousineau, Lauer, & Peacock, 2004; Wu, Chwan-Yi, Wu, & Tu 2004; McAdam & McCormack, 2001). It also reduces the need for the manufacturing organisation to carry excessive inventory and its associated costs. In order to achieve these goals an objective method of measuring supplier performance is required in the form of a supplier performance-measuring tool.

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In recent years considerable attention has been paid to the subject of supplier performance evaluation (Cousineau, Lauer, & Peacock, 2004; Beamon, 1999;) and selection methods (Degraeve, Roodhooft, & van Doveren, 2005, Neely, 1999; Monczaka, Trent & Callahan, 1993). This paper presents a case study of a large multinational manufacturing organisation in its quest to objectively measure to help measure and manage the performance of suppliers. To do this a supplier performance evaluation tool is developed based on best practice. The tool is designed to meet the needs of the subject organisation, allowing it to objectively assess its supplier base, in order to rationalise the number of suppliers that appear on its approved manufacturing list (AML). This aims to improve the efficiency and operation of the materials supply chain, by rationalising the redundant and poor performing suppliers and developing stronger collaborative relationships with a group of key preferred suppliers. Suppliers that show potential for improvement can be identified and time and resources can be justifiably allocated to them as part of a supplier improvement programme. A profile of the organisation in question is presented and its problems relating to inventory management are highlighted. The supplier performance evaluation tool is then presented and finally the outcomes and benefits arising from the implementation of the tool are identified and briefly discussed.

2. Profile of the Case Organisation

The organisation in question is a large multinational that develops global end-to-end uninterruptible power supply (UPS) products and services that provide protection against data loss. The company's manufacturing facilities are based in the USA, Ireland, Switzerland, Philippines, China, India, and Brazil and sales offices are located throughout the world. Product offerings are shipped to nearly 120 countries. The company employs approximately 5,400 full-time people worldwide, with a turnover of $1.3 billion. The organisation has been in business for over twenty years and consequently has built up an extensive list of approved suppliers. There has always been reluctance to remove suppliers from the approved manufacturing list (AML) once a supplier has been audited and approved as it gives the organisation the security of having alternatives should an unforeseen situation arise. This has resulted in an average supplier to part number ratio of between 6.8 suppliers for each part number. As a result, the number of suppliers on the organisation's AML has become difficult to manage effectively. At the start of this study in October 2000 the organisation had 23,225 suppliers and carried on average $15.24 million worth of inventory and the purchasing function was struggling to manage the materials supply base. There were not enough resources within the purchasing and quality assurance departments to effectively manage the large number of suppliers on the AML. A method was required to help rationalise the number of suppliers used by the organisation. The decision was made to downsize the AML by removing the suppliers that had ceased trading together with the suppliers of part numbers that were obsolete, and improve the efficiency of the materials supply chain by developing closer relationships with a core group of preferred suppliers. After removing old and obsolete suppliers from the AML, a method was needed to objectively assess the performance of the remaining suppliers in order to identify those that best meet the needs of the organisation. The aim was to reduce the average number of suppliers for each active part number on the AML from 6.8 per part to 2.

3. Development of the Supplier Evaluation Tool

A supplier performance evaluation tool was developed to provide the organisation with the ability to measure suppliers with respect to three key criteria. These are (a) on time delivery, (b) quality and (c) total cost (based on the cost of quality). The rating system is based on inventory items only and each metric is combined using a weighted average. Each of these indicators is explained in more detail.

3.1 On Time Delivery (OTD)

A supplier's on time delivery (OTD) metric is a comparison of the promise date and the actual date the material or part is received. The acceptance tolerance is on time and up to five days late. Five days late is allowed to compensate for weekends and holidays, allowing the organisation time to enter the receipt on

the system and to compensate for promise date maintenance. OTD is weighted at 40% of the total supplier score.

3.2 Quality

A supplier's quality indicator is a percentage of the number of parts returned to the supplier (RTS) compared to the number of parts received from a supplier, or any other issue that would initiate a supplier corrective action request (SCAR). The result is reported on a part per million (PPM) basis and the final points are awarded using a part per million (PPM) conversion table (see Table 1). Part per million is the average number of defects per unit observed during an average production run, divided by the number of opportunities to make a defect on the product under study during that run, normalised to one million.

Table 1 PPM Conversion Table

PPM	Yield	Sigma	Points
>66,810	<93.3190%	<3.00	0.0
66,810	93.3190%	3.00	2.0
38,950	96.1050%	3.25	4.0
22,750	97.7250%	3.50	6.0
11,870	**98.8130%**	**3.75**	**8.0**
6,210	99.3790%	4.00	10.0
2,890	99.7110%	4.25	12.5
1,350	99.8650%	4.50	15.0
560	99.9440%	4.75	17.5
233	99.9767%	5.00	20.0
86	99.9914%	5.25	25.0
32	99.9968%	5.50	30.0
10	99.9990%	5.75	35.0
<3	>99.9997%	6.00	40.0

The quality indicator accounts for 40% of the overall score. Data is captured from all inventory purchase order types. Purchase order costs are used to determine receipt costs and returned to supplier (RTS) costs. More specifically, data is captured in the report if the receipt transaction date and promised date (or need by date if promise date is blank) is within the date range specified or the monthly window. Data is also captured in the report if the RTS transaction date is within the specified date range. It is important to note that RTS data can only be captured if the "Defect Description" field is empty, or if the field contains "External Supplier Error" (see Table 2). This is to ensure that only external supplier error data is included. Some RTS transactions are performed as a result of internal causes such as overstocking, incorrect part specification, parts that are damaged by production. These errors should not be attributed to the supplier.

3.3 Total Cost

A supplier's total cost metric is derived from a ratio of total cost of quality dollars divided by the total dollars worth of materials received for the period. The cost of quality can be described as a method of expressing the cost of poor quality in terms of what it is costing the company in the form of prevention costs, appraisal costs and failure costs. Examples of prevention costs would be in process audits, parts qualification and preventive maintenance. Appraisal costs occur in the form of first off part inspection, supplier audits and sample-incoming inspections. Examples of failure costs would include scrap, rework and corrective actions. These costs are totalled and can be expressed as a percentage of a key metric that is used by the organisation e.g. expenditure on the purchase of materials, total sales or operational costs such as materials, labour and overheads or a given time period such as, a month, a quarter or a year. The total dollars received is determined by querying the receipts falling into the date range and using the part cost on the purchase orders. The cost of quality dollars charged to a supplier is determined by querying the cost of quality general ledger account code in the accounts payable module in the organisations enterprise resource planning system. This metric carries a 20% weighting of the supplier's overall score.

3.4 Total Supplier Score and Supplier Ranking

Suppliers are graded based on the total supplier score. If two suppliers have the same score they receive the same grade. For this reason a supplier that receives a score of 300 is not graded 300th out of all suppliers but is graded 300 out of the total number of scores. There are fewer grades than there are suppliers. Also, the number of grades generated depends on the type of report. The same supplier can have different scores and grades in different reports. For example, there are more grades in factory / category reports because supplier names supplying multiple factories or organisations are listed many times.

Table 2 Supplier Defect Explanation Code List

Defect Code	*Defect Description*
QA-02	Dimensions out of Specification
QA-04	Electrical properties out of Specification
QA-06	Material Properties out of Spec
QA-08	Contamination
QA-10	Not Functional
QA-12	Assembled incorrectly
QA-14	Incorrect or missing part
QA-16	Solder
QA-18	Packaging, Labelling Issue
QA-20	Open or Short
QA-24	Leaking
QA-26	Structural Integrity Compromised
QA-28	Damaged
QA-30	Visual or Surface Defect
QA-32	Causes in-process test failure
QA-34	Causes final test failure
QA-36	Other, Supplier issues

4. EMEA Requirements for the Tool

This tool was implemented across all the organisations' regions. It helped to objectively assess the organisations supplier base and consequently the organisation succeeded in rationalising the number of suppliers on its approved manufacturing list (AML). However, the purchasing department for the EMEA region determined that only 477 suppliers had been used in the previous six months with an expenditure of over $23,162,000. It was also identified that 34 of these suppliers accounted for 77% of this expenditure and all of these were JIT suppliers (JIT suppliers were excluded from the OTD calculation for the tool because they are purchased using a blanket order that has a promise date that may be up to a year in the future and these shipments would appear too early using the purchase order promise date). In other words, at EMEA level JIT suppliers comprised 77% of the local purchasing expenditure and less than 10% of the local active supplier base. Therefore, it was decided that the supplier performance-measuring tool had to be refined and adapted to incorporate these suppliers.

In order to identify JIT suppliers in the EMEA region that could be removed from the AML as part of the improvement programme a set of rules for measuring supplier performance was drafted. The procedure for determining this supplier target group focused on material that was returned to suppliers (RTS) within a defined time period. A time period would typically be three to six months. These rules are:

- If the number of parts returned to the supplier (RTS) in a specific time period is greater than 10,000 pieces the part is investigated further with the supplier.
- If the RTS figure is greater than 10% for a part number in a specified time period the part is investigated further with the supplier.

- If the total value of the parts that have been returned to the supplier in a time period is greater than $5,000 the part is investigated further with the supplier.
- If the value of parts returned to the supplier in a time period is greater than 0.5% of the total value of the parts received the part is investigated further with the supplier.

Targeted suppliers were then contacted and informed of their RTS performance and a supplier corrective action request (SCAR) is issued. Suppliers must respond with an effective resolution to the SCAR within an agreed time period, usually ten working days. If there is no response to the SCAR within the agreed time period, or the proposed resolution to the SCAR is unsatisfactory or ineffective, the option lies with the European supplier management team to re-audit the supplier or commence the disqualification procedure for the part number sourced from the supplier. Furthermore, if the response to the SCAR by the supplier is not satisfactory, it may be returned to the supplier for further work. The organisation may propose targets for improvement and work with the organisation to develop an acceptable methodology for improvement. If the supplier corrective action is received and acceptable within the agreed time limit the next step is to determine the scope of the improvement. Suppliers were provided with an extensive training programme. This involves establishing a meeting with each supplier in the target group where the following items are covered:

- The organisation's supplier management process
- Results of quality history analysis for each supplier and how they are positioned in their peer group
- Proposed targets for improvement (subject to negotiation)
- Methodology to be used in achieving the required improvement (the supplier should lead this item, but the organisation will assist where required)
- Expectations in terms of responsiveness and issue closure
- Schedule audit requirements (if necessary)

Suppliers who pass the test are designated "Preferred Suppliers" and provided there is a future requirement for their parts further business is allocated to them.

5. Outcomes and Benefits Arising

The process of assessing and rationalising the number of suppliers has had a significant impact on the organisation. The process resulted in a three fold reduction in the number of suppliers. This represents 2.4 suppliers for each part number. Over the three year period local inventory costs in EMEA were reduced from a high of just over $15.42 million to just over $5.86 million, a reduction in value by a factor of just over 2.6. The reduction in the amount of inventory that is carried by each manufacturing location has resulted in significant financial savings for the company. Specifically, there has been a significant reduction in direct storage costs. These costs relate to the costs of holding items in inventory and include product depreciation, obsolescence and deterioration as well as costs associated with product spoilage and breakage. The company has also witnessed a significant reduction in rented offsite and internal warehousing facilities which also impacts on the cost of heating, lighting and security.

By selecting a smaller group of suppliers, closer relationships with key suppliers were developed. In many instances the preferred suppliers have taken on the responsibility of automatically replenishing the stock of inventory held. The lead time for new product development was significantly reduced by having closer associations with preferred suppliers and integrating them in to the company's processes. Key suppliers can envisage and begin pre-production work to reduce the total development time. They may also anticipate potential problems in advance and process changes and modifications can be made earlier to meet the needs of the new product. The organisations preferred suppliers have also benefited from this process. Integrated suppliers have more visibility and they can determine the organisation's materials requirements in advance. This visibility allows suppliers to better plan their own production efforts and gives them forewarning of changes in the manufacturing organisation's plans. It also enables them to

better coordinate deliveries of materials with other suppliers in the supply network. It reduces their need to carry excessive inventory and improves the material quality by providing exactly what manufacturing requires when it is needed. This has a direct impact on their costs, quality and flexibility.

6. Conclusions

Progressive organisations are seeking to optimise their supply chains in order to gain and maintain competitive advantage in turbulent markets. To do this they must create alliances with their supply chain partners in general and suppliers in particular. The must also be selective with whom they form close business relationships. Therefore they must identify the best suppliers that will satisfy their specific requirements, provide high levels of operational performance and complement their competencies in order to advance their market position. Reducing the number of approved suppliers on an organisation's approved manufacturing list can result in reduced inventory and significant savings for the company. Quality is increased, lead time is reduced and there is a reduction in the number of errors and defects. By identifying the best performing suppliers with which to form closer relationships it can be possible to integrate them more closely in to the organisation and enable them to assist with organising the delivery of component parts to arrive when they are required. Key suppliers can add their knowledge and experience to development initiatives, potential problems can be anticipated in advance and process changes and modifications can be made earlier to meet the needs of the new product.

Methods or tools developed to assess the performance of suppliers must be based on best practice and adapted to meet the requirements of the environment in which they are deployed. It is also important that the organisation evolves to accommodate the tools and implemented management systems. The end users of the tool should be closely involved with its development in order to ensure the tool meets their needs. Specifically, they should participate in the problem identification phase from the outset. This significantly contributes to their ownership, understanding and operation of the tool. It is also imperative that the development and operation of the tool is adequately resourced by ensuring there are sufficient personnel available with the correct skills for its development and execution, that they are adequately funded and that they have the correct tools and materials in the form of access to accurate data and data processing tools. Finally we learned that senior management must have a strong commitment to the initiative as a means for continuous improvement in the supply chain. Without the backing and support from the top management team any supply chain initiative is destined to fail. Such initiatives must be driven by example at a senior management level.

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