Developing a model of total cost of ownership for evaluation of purchases at Saab Microwave Systems

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This article is based on a study which was conducted at Saab Microwave Systems in Gothenburg. The aim was to develop a model of total cost of ownership for the purchasing department to use for evaluation of purchases. The study is based on a master thesis in Engineering Logistics at Lund University, Faculty of Engineering.

Key words: Purchase, evaluation tool, measurement focus, total cost of ownership, purchasing process, activities, cost drivers, costs, total cost of ownership model.

Introduction
The business environment of today is characterized by an escalating globalization and competition. This creates increasing requirements on internal and external co-operation. More and more companies choose to concentrate on a limited part of the supply chain. This leads to companies becoming more dependent on the external suppliers and makes the relationships between the company and its suppliers more important. As a result of this the importance of the purchasing functions changes drastically and in many cases the share for purchase is today more than half of a company’s turnover.

Due to above described changes, the way in how purchase are made have a more strategic meaning now than before. The purchase process is today the co-ordinator of the company’s internal and external resources.

Throughout history, the price was the most important measure for a purchase. As a result of the development in production approaches in the 70’s, with concepts as Just-In-Time, other factors also became important. Price was no longer the only factor of importance; also delivery time, quality, delivery flexibility, service level and the suppliers’ ability to co-operate were of significance.

Saab Microwave Systems is a supplier of Radar Systems and the solutions developed have the purpose of providing customers with information superiority. With more than 50 years experience of radar development Saab Microwave Systems is a world-leading centre of competence for microwave and antenna technology.

Within the purchasing function at Saab Microwave Systems the focus today is mainly on transactions and with a large focus on price. There is no good strategic tool for evaluation of purchases and this

makes the evaluation dependent on time and person. Furthermore; an evaluation that is mainly based on price shows nothing about how the purchasing department manages to lower the total cost.

Problem formulation
A big challenge that Saab Microwave Systems faces is to get focus on the cost thinking throughout the entire business unit. Another challenge is to pay attention to where in the purchasing process costs arises for purchases and purchased products.

The current evaluation is mainly based on price but also aspects as dealing costs, delivery performance and product quality are measured and evaluated. However; a good strategic evaluating tool for calculation of the total cost for a purchase is missing. A strategic tool that considers more aspects and that in a better way can reflect the purchasing function’s performance is needed.

The problem formulation is divided into three parts where the aim of part 1 is to constitute the foundation for the mission formed in part 2. The aim in Part 3 is to answer questions around problems with measurement and integration.

Part 1 – Map costs and cost drivers
- Where in the purchasing process does the largest cost occur?
- Which cost drivers have a great impact on the total cost of a purchase?

Part 2 – Develop a model of total cost of ownership
- To develop a model for calculating a purchase’s total cost to be used at evaluation.

Part 3 – Use the model of total cost of ownership for evaluation and measuring
- How can the model of total cost of ownership;
- be used to give a more effective evaluation of the purchase process?
- be used in context with measuring?
- contribute in the work against a increased measurement focus with internal and external integration?

Purpose
The purpose of the first part of the thesis work is to identify where in the purchasing process large costs take place and to show what effect different costs have on a purchase. This will be done by identifying, considering and measuring the activities related to a purchase in order to see where in the purchasing process relevant costs occur and what the cost affect is.

The main purpose for the thesis work is formed in part 2; to develop a model for calculating the total cost of a purchase. The developed model of total cost of ownership (TCO model) is meant to be used for evaluation of purchases for a more effective and consistent evaluation.

The purpose of part 3 for the developed TCO model is to contribute to a more effective evaluation that can give a better review of the purchasing function’s performance. The intention with the measurement questions is to have a discussion around how expanded measurements focus, and a total cost of ownership thinking, can contribute to change the focus within the organisation.

Theoretical frame of reference
To perform this research, several theoretical areas of interest have to be studied. To be able to identify the activities and cost drivers in the purchasing process; a theoretical model for the purchasing process done by Van Weele was studied. The main focus of the theoretical frame of reference is the total cost of ownership.

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concept. Definitions of the concept\textsuperscript{7}, reasons for a development\textsuperscript{8}, in what context it can be used\textsuperscript{9}, benefits\textsuperscript{10} and difficulties\textsuperscript{11} are some of the aspects that have been covered. In addition, the development and implementation process for this master thesis is based on an eight stage process developed by Ellram\textsuperscript{12}, “Framework for Total Cost of Ownership Model Development”. See Figure 1.

The development process starts with identifying the need and interest. The second stage is to determine the purchased item or items of interest. This is followed by the third stage; to decide the development team. At stage four, the real model development work begins. To begin with, relevant costs must be identified and than the team determines which of the costs that are of importants and which costs that can be determined. After that the work with collecting and documenting cost data starts followed by implementing and testing of the model. Stage six includes analysis of the model’s results and an evaluation of the development process. Stage seven handles linking of the total cost of ownership to other systems. The final stage is about the needs for continued update, monitoring and re-evaluation of the total cost of ownership system.

To ease the understanding and to give a better overview, the considered costs can be divided into related categories. The costs in this master thesis will follow the categories created by Ellram.\textsuperscript{13}

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\textsuperscript{7} Ellram, A Framework for Total cost of Ownership, p 49.
\textsuperscript{8} Degraeve & Roodhooft, Effectively Selecting Suppliers Using Total Cost of Ownership, p 6.
\textsuperscript{9} Ellram, Total Cost of Ownership – An analysis approach for purchasing, p 10.
\textsuperscript{10} Ellram, Total Cost of Ownership – An analysis approach for purchasing, p 10.
\textsuperscript{11} Ellram, Total Cost of Ownership – An analysis approach for purchasing, p 7.
\textsuperscript{12} Ellram, A Taxonomy of Total Cost of Ownership Models, p 2.
\textsuperscript{13} Ellram & Siferd, Purchasing: The cornerstone of the total cost of ownership concept, p 7.
\textsuperscript{14} Ellram (1993) A Framework for Total cost of Ownership.
\textsuperscript{15} Abnor & Bjerke (1994) Företagsekonomisk metodlära.
thesis work is the theoretic and empirical studies executed regarding collecting information. The thesis work consists of both qualitative\textsuperscript{16} and quantitative\textsuperscript{17} data which is collected through interviews, a survey and from databases.

A symbolic model\textsuperscript{18} is used for the total cost of ownership model because it consists of values on costs in combination with relations and formulas between input and variables. For the testing of the models reliability tests have been done before further calculations with the model.

Results

Activities and costs

Activities and costs were chosen with the intention of representing the fundamental costs and the costs with a large impact on the total cost. The chosen costs are divided into categories, mentioned in the theory. The following costs were chosen to work with:

\textit{Category Price}\n
\begin{itemize}
  \item price, payment term, term of delivery, freight cost
\end{itemize}

\textit{Category Delivery}\n
\begin{itemize}
  \item delivery performance, cost for goods reception, cost for warehousing
\end{itemize}

\textit{Category Quality}\n
\begin{itemize}
  \item cost for arrival control, product quality, cost for returns
\end{itemize}

\textit{Category Communication}\n
\begin{itemize}
  \item cost for order placement, cost for billing
\end{itemize}

\textit{Category Management}\n
\begin{itemize}
  \item cost for maintenance of the supplier
\end{itemize}

The cost drivers and data allocated for these costs will be stated below. For some costs simplifications are used in the calculations. In these cases no other defendable way or fair data to calculate the cost based on the true cost drivers was possible to come up with. Instead, simplifications in form of percentages applied by the company were used. For some costs there were no defendable way for calculating the costs within the timeframe for the thesis work and for these costs an analysis and discussion about the cost drivers were made instead.

The \textit{price} consists of a price per unit and an associated cost which is the set up cost or program cost. Also; the order quantity is an important factor for calculating the total unit price per product. The \textit{payment term} can vary between different numbers of days and it is calculated using the rate of return to measure the size of which the capital can pay interest on.

The \textit{freight cost} will be calculated using a freight percentage based on the price. This is a simplification as the real cost drivers for freight are weight, size and transportation distance. It also depends on the delivery agreement between the company and the supplier.

\textit{Delivery performance} is one of the costs that were not possible to calculate. However; a suggested way to calculate the cost was developed, using the cost that a delayed delivery causes in combination with a probability over a certain supplier’s delivery performance.

For the \textit{cost for goods reception}, a mean number of deliveries received per month was used. Combined with the total time the workers at the station contributes with during a month, the cost could be calculated. This is also a simplification as the real costs will depend on the good’s size and the amount of inconvenience the received delivery from a supplier causes.

\textsuperscript{16} Björklund & Paulsson (2003) \textit{Seminarieboken}.
\textsuperscript{17} Holme & Solvang (1997) \textit{Forskningsmetodik}.
\textsuperscript{18} Wallén (1996) \textit{Vetenskapsteori och forskningsmetodik}. 
To calculate the cost for warehousing a percentage based on the price was used. This is also a simplification since the true cost drivers for warehousing costs are the volume of the product, the size of the security warehouse, time spent in the warehouse and so on.

The cost for arrival control was based on time estimation of handling an arrival control for a specific type of article. Consideration was taken to type of product, the amount, type of control and the experience of the personal.

The cost for product quality consists of the cost for reclamation and the cost for delayed delivery. The cost for returns was calculated considering all the time spent on returns from the involved functions. However; the cost for product quality was not possibel to decide since the cost for delayed delivery could not be determined. Using a probability over a certain suppliers’ product quality, a cost for product quality could be determined.

The cost for order placement was calculated from data for time estimations made by the junior buyers, representing the time spend on an activity. The activities considered for order placement were delivery surveillance, the actual order placement and the time spend on offer work.

The billing cost was calculated in the same way as the cost for goods reception. Using a mean number of bills processed per month allocated on the number of employed working with these bills. This is also a simplification since the time can vary depending on supplier.

For the last cost; cost for maintenance of the supplier, no data could be found. Instead, the cost drivers were analysed and determined. The cost drives considered were the supplier’s product quality and delivery performance, the existing relation with the supplier, the suppliers geographic location, the purchase value from the supplier, type of product purchases and the supplier market.

**The total cost of ownership model**
The model developed includes the costs where supportable and defendable data could be found. Calculations were then made with the model to test the reliability and to analyse the results.

The conclusion of the results from the reliability tests and calculations is that the developed TCO model gives partly reasonable and reliable result. Due to the fact that not all costs could be included in the calculations and the simplifications made for some calculations, the results of the TCO model can not be evaluated and analysed in detail. This means that the reliability for all the costs could not be evaluated and the reliability for the total result can because of that not be secured. The model can therefore not show the real effect of different costs since not all costs are included in the model.

The measured costs combined with the other aspects and cost drivers considered gives a good foundation for a continued development of the TCO model.

**Conclusions**

**Part 1 – Costs and cost drivers**
The first problem formulation aimed to identifing where the largest costs for a purchase arises. For the development of the TCO model, all activities in the purchasing process have been studied and from that the value adding activities considered relevant where chosen. The development process and the results from the calculations and analyses shows that activities contributing to the largest costs in the purchasing process are the arrival control and the freight. The study also indicates that large costs occur for delivery performance, product quality and maintenance of the suppliers. This could however neither be established nor denied.
The aim of the second question formulation, connected to the purchasing process, was to show which impact different costs have on a purchase and to decide which cost drivers that have a large impact. The large costs mentioned above results in the largest cost drivers being the characteristic of the product, the time the purchaser spent on the activity and the extent of the re-planning in the production. The supplier’s performance, the relation with the supplier, the contact with the supplier and the supplier’s geographic location are also considered as large cost drivers.

**Part 2 – Developing the model of total cost of ownership**

The problem formulation in part two was to develop a TCO model for calculation of the total cost for a purchase to be used for evaluation.

Total cost of ownership is a very extensive concept which makes delimitations necessary. This leads to some limitations of the model. In this study a limitation was made to see the process from the time of the need arised to the time the material goes into production. The total cost of ownership model does not include all possible costs that can occur. It consists of the chosen costs that were considered to constitute large, important and critical costs.

The estimation of the total cost for a purchase is complex and involves a large number of conditions that can vary. The developed TCO model contains a framework of the fundamental costs which constitutes a base for a continued development. In addition to the model a number of other activities and cost drivers have been taking under consideration and have been studied and analysed. Due to the fact that no adequate cost data could be obtained in the timeframe for the thesis work, these costs were not incuded.

It is therefore important to remember that the TCO model only gives a relative total cost since all costs are not included. The costs included in the calculations are; price, payment term, freight cost, cost for order placement, cost for goods reception, cost for arrival control, cost for warehousing and cost for billing.

From the results of the calculations made, the model of the total cost of ownership is considered to give fair result for those costs that are based on the true cost drivers. The reliability of the results for the costs were simplifications were being used is harder to determine. It is hence difficult to determine the true impact of a cost on the total cost of a purchase. In addition to this, the review and discussion about chosen costs and associated cost drivers are considered to constitute a good foundation. This prepares for a continued development and implementation of the TCO model.

**Part 3 – Evaluation and measuring – use of the model**

By using the TCO model for evaluation of purchases in the future, a more effective and supportable tool is received that covers an increased number of aspects. This provides a more useful, and also a more adequate, evaluation since all purchases can be evaluated on the same basis.

A development of total cost of ownership is cross functional thinking and contributes to extended internal integration. Through reducing the total cost instead of the unit costs of the purchased products, it also gives objectivity.

During a continued development of the TCO model, the recommendation is to collect data for those costs and aspects that was not possible to fulfil during the thesis work. With these costs the model can process the supplier important aspects as well. Effort and focus should also be put on finding the real costs from the true cost drivers and to use that as allocation basis.
instead of using currently made simplifications. This will contribute to the extent of the models’ result and profit, and the model will be more reliable and of a greater use.

References


Electronic resources