The current issue and full text archive of this journal is available at
www.emeraldinsight.com/0265-671X.htm

Received 2 May 2013
Revised 1 September 2013
Accepted 5 September 2013

QUALITY PAPER

Implementing an integrated ABC and TOC approach to enhance decision making in a Lean context

A case study

Majed Alsmadi
Department of Engineering and Knowledge Management, Coventry University, Coventry, UK
Ahmad Almani
Department of Business Administration, Philadelphia University, Amman, Jordan, and
Zulfiqar Khan
Coventry Business School, Coventry University, Coventry, UK

Abstract

Purpose – The purpose of this paper is to implement an integrated activity-based costing (ABC) and theory of constraints (TOC) approach to enhance decision making in a Lean company.
Design/methodology/approach – Based on the literature, this paper proposes an integrated ABC and TOC approach and applies it to a Lean plastic manufacturing company to improve its product-mix decision.
Findings – The results of the case study show that the current conventional product-mix decision used by the company and the proposed integrated approach can give significantly different results concerning the optimal product-mix and the associated bottlenecks. Moreover, the paper suggests that managers who implement Lean production without utilising a supportive management accounting system may experience disappointing financial results.
Research limitations/implications – The validation of the suggested method is based on a single case study with an action research approach. For future research, the authors suggest the implementation of the approach in different industries.
Practical implications – Overall, the integration of ABC and TOC provides managers with an accurate, timely and reliable tool that can help in making decisions about pricing, production line development, process improvements and product-mix.
Originality/value – This paper contributes to Lean and management accounting literature by demonstrating the value of a method of integrating ABC and TOC. Also a case study is chosen for the empirical aspect of the study as there are no case studies available in the literature that illustrate a real life case of integrating ABC and TOC within Lean companies as an alternative to the current used cost accounting systems.

Keywords Case study, Activity-based costing, Lean context, Product-mix, Theory of constraints
Paper type Research paper

International Journal of Quality & Reliability Management
Vol. 31 No. 8, 2014
pp. 906-920

0265-671X
DOI 10.1108/IJQRM-04-2013-0063

The authors would like to acknowledge the constructive comments made by the anonymous reviewers on the earlier version of this manuscript. The authors also appreciate the comments from the editors of *International Journal of Quality & Reliability Management* that helped make this a better manuscript.

1. Introduction

In recent years, many manufacturing companies have adopted Lean manufacturing to meet increasing competitive pressures. These companies have moved from mass production to producing small batches customised to the demands of customers. This change in the manufacturing environment has led researchers and managers to search for explanations, which could account for why increasing efficiencies is not associated with increasing profitability and competitiveness. Many Lean companies get into financial troubles not because of bad products or services, but because they lack appropriate cost accounting systems. They often find that the emphasis of traditional costing system on labour efficiency and utilisation promotes non-Lean behaviour such as manufacturing large batches, building high inventories, hiding waste, and focusing on financial rather than operational performance measures (Carnes and Hedin, 2005).

Moreover, the traditional cost accounting system fails in providing Lean companies with accurate, timely and reliable information to managers in order to make decisions about pricing, production line development, process improvements and product-mix. Determining the right and optimal product-mix of a company is a vital requirement to increase its profitability. Companies usually face the question on what products and quantities they should produce in order to become more profitable. Most companies find themselves producing either overpriced or underpriced products. Neither situation is good because if a product is overpriced the company will likely not be competitive and it will lose its business, and if the product is underpriced the company will lose money on the sales it makes (Tioanda *et al.*, 1999). This could happen because companies did not produce the optimum product-mix. Integrating activity-based costing (ABC) and theory of constraints (TOC) together can provide management with more accurate information about the optimal product-mix.

ABC is a method that is increasingly used to assign costs to products based on the resources they consume and services produced by the organisation. It looks at the manufacturing system as being composed of activities. It assigns the costs of these activities to cost objects by using cost drivers that represent the consumption of indirect resources by cost objects. On the other hand, TOC is a management philosophy that views an organisation as a complete and complex system that consists of a number of components that interact with each other. The basic concept of TOC is that the goal of a company is to make money, and there are various constraints that prevent each company from reaching this goal and management should focus on these constraints in order to improve its performance (Goldratt and Cox, 1992).

Although ABC and TOC are based on different sets of assumptions and every philosophy has its superiority over the other, they should not be treated as mutually exclusive approaches. The integrated ABC and TOC approach, demonstrated in this paper through a case study, has the potential to help Lean companies in determining their optimum product-mix and improving their financial performance. However, before beginning the case description, we would like to elaborate on the literature review and theoretical framework of this paper.

2. Literature review

Since the beginning of the twenty-first century, many manufacturing companies have faced dramatic changes in their business environment. Customers today demand high-quality products with varying production requirements, and often require deliveries in small lot sizes with short-lead times (Fullerton and Wempe, 2008). In response to these demands, manufacturers are becoming increasingly aware of the

importance of modern management philosophies which can provide them with competitive advantage. They have realised that improving quality and productivity on a continual basis and serving customers in a timely manner are the keys to successfully compete in the business environment. In the current fierce competitive environment, Lean manufacturing has come to improve customer satisfaction as well as organisational effectiveness and efficiency. The emergence of Lean concept has been one of the major developments in management practice in the last two decades and became a part of the fabric of doing business (Corbett, 2007).

The term Lean was coined around 1990, primarily for the aim of achieving improvements in most economical ways with special focus on reducing waste (Dahlgaard and Dahlgaard-Park, 2006). The philosophy is a generalisation of such partial approaches as just-in-time (JIT), TQM, time-based competition and concurrent engineering (Matthews *et al.*, 2000). Lean aims to optimise costs, quality and customer service constantly. It does so by engaging and equipping employees to focus on creating and delivering value in the eyes of the customer and eliminating whatever does not contribute to this goal (Bhatia and Drew, 2007). Lean manufacturing uses various types of tools and techniques in order to improve processes. Major tools and techniques of Lean manufacturing are: cellular manufacturing, value stream mapping to encourage single piece flow, visual workplace organisation (5Ss), set up time reduction methods, inventory management and Kaizen. The use of these tools and techniques by companies has had a significant influence on management accounting systems (Drury, 2006).

The Lean concept is rapidly becoming the dominant paradigm in manufacturing which covers all activities of an organisation, from product design to after sale service. The arbitrary cost accounting system underlying the traditional manufacturing paradigm assumes that the production context is given and existing in a stable environment (Kaplan, 1983). In contrast, Lean production does not assume the production context as given, wherein optimal decisions should be taken. These changes in the environment have led researchers and managers to search for explanations, which could account for why increasing efficiencies is not associated with increasing profitability and competitiveness.

The adoption of Lean production by companies requires changes in the management accounting system; employing different methods of costing products, accounting for increasing overhead costs and deciding which processes truly add value to a product. The need for making these changes has been known at least since the early 1980s. However, the nature of these changes is not obvious and is the subject of a continuing debate among scholars (Cooper and Kaplan, 1988). Cooper (1994) argued that a well-designed management accounting system should support the adoption of a new production strategy and act as a bridge between production and other functions. Consequently, an inappropriate management accounting system is likely to have a negative effect on the process of adopting a complex production strategy such as Lean production.

The integrated ABC and TOC approach, demonstrated in this paper through a case study, has the potential to help Lean companies in determining their optimum product-mix and improving their financial performance. This section has provided a summary of the relevant literature and will be followed by the theoretical framework of the study, the research methodology, including research question, data collection methods and the case study. Finally, the paper presents the main conclusions, the limitations of this research, obstacles, future work, managerial implications and lessons learned.

3. Theoretical framework

Lean production and lean accounting

The Lean concept has changed the way many leading companies deliver products to their customers. It aims to improve productivity, reduce cost, enhance flexibility and create better value for customers. Lean production seeks to integrate all business processes, functions and employees into a unified, coherent system whose sole purpose is to provide better value to customers through continuous improvement and using Lean principles and tools to reduce inventory, defects, dedicated floor space, cycle time and the cost of scrap and rework (Grasso, 2005). In other words, Lean production is a continuous decisive attack on all types of waste. However, the origin of the Lean philosophy is usually attributed to Toyota, whose production system was originally referred to as JIT, currently called Toyota Production System (TPS). Building on the success of TPS, proponents of Lean production advocate five fundamental principles (Womak and Jones, 1996):

- define value and identify the value stream for each product;
- eliminate all unnecessary steps in every value stream;
- make the value flow continuously;
- base flow on customer pull; and
- pursue perfection continuously.

Lean is most well known as a manufacturing system, but to be successful it has to be applied much more broadly as a complete business system (Grasso, 2005). It lets companies produce high-quality products at reasonable cost in short time. A Lean strategy emphasises single piece flow, reduces inventory levels, saves production space and handles costs. Another element of Lean is cellular manufacturing where work is often achieved by cells of workers producing a complete product rather than functional departments transferring work in process sequentially along an assembly line. Such configuration saves time and space on the factory floor and improves product tracking and quality. Lean attempts to reduce inventory at all levels since it is considered as negative factor to be controlled rather than an asset adding value to the company. The value stream includes all those processes necessary to serve the customer and produce value and usually it extends the factory floor to include even suppliers and distributors.

In such manufacturing environment, informational needs of companies are changing. Yet, the accounting profession remains slow to respond. Traditional standard costing systems continue to proliferate, even in a Lean manufacturing context (Fullerton and McWatters, 2004). The Lean environment requires a supportive management accounting system. A relatively new management accounting approach potentially better suited to providing information supportive of Lean initiatives is beginning to capture the attention of Lean practitioners across the globe (Fullerton and Kennedy, 2009). It is popularly termed Lean accounting or accounting for Lean which refers to the concept of changing the traditional management accounting system to one that is more relevant for a Lean environment. This new concept is much more critical to a company's ultimate success with Lean implementation; yet, it has received a relatively low adoption rate partly because of the implementation challenges.

Overview of activity-based costing

ABC is designed to prevent cost distortions in product costs and provides a process view which traditional cost accounting cannot provide. Cost distortions were

traditionally caused by allocating manufacturing overhead over a single overhead allocation base which is common to all of the company's products, typically direct labour (Anderson, 1995). ABC establishes homogeneous cost pools where each of them is caused by a single driver. Resource drivers assign resources to activities and activity drivers measure the demands placed on activities by cost objects. ABC recognises the causal relationship of cost drivers to cost activities by measuring the cost and performance of process-related activities and cost objects. Costs are assigned to activities based on their use of resources, then assigned to cost objects based on their use of activities (Raffish and Turney, 1991).

ABC assigns costs on the basis of a multi-staged costing level at which the costs are incurred in the production process. The standard case includes four levels: unit level, batch level, product sustaining and facility sustaining. The use of multiple drivers and cost hierarchies enables ABC to more accurately model the relationship between resources used by activities and cost objects. ABC models resource consumption, rather than resource spending. This means that ABC estimates the cost of resources used in organisational processes to produce outputs (Fu, 2000).

Where resources are acquired as needed, the cost of resources supplied would generally equal the cost of resources used. However, organisations may acquire resources that are supplied in advance of usage. Consequently, the expenses of supplying the service capacity from these resources are incurred independent of usage (Cooper and Kaplan, 1992). While the cost of acquiring the resources may be fixed in the short run, the quantity of resources used each period fluctuates according to the activities performed for the outputs produced. Any resource acquired that is not consumed is classified as unused capacity (Fu, 2000).

Overview of TOC

TOC is a systematic methodology that has been developed to assist organisations to think about their problems (Zadry and Yusof, 2006). The methodology recognises that system constraints limit the performance of a system and proposes a set of concepts to manage the constraints. TOC is built on the premise that every organisation faces at least one constraint. A constraint is anything that limits the performance of a system relative to its goals. The constraint is the focal point because improvements in non-constraints do not translate to improvements in the whole system. TOC suggests that (Gupta and Kline, 2008):

- the goal of an organisation is to make money without violating certain necessary conditions such as customer satisfaction, employee satisfaction and security;
- there are three performance measures: throughput (the rate at which the system generates money through sales, represents sales revenue less direct materials), inventory (all the money that the system invests in purchasing things which it intends to sell) and operating expenses; and
- improving the process can be achieved by focusing improvement efforts on its weakest link or constraint.

The implementation of TOC can provide an effective opportunity for organisations to compete and lead (Gupta *et al.*, 2010). Goldratt and Cox (1992) suggested five focusing steps for managing constraints:

- identify the system's constraints;
- exploit the system's constraints;

- subordinate everything else to the above decision;
- elevate the system's constraints; and
- go back to Step 1.

As a summary, organisations manage constraints through the five focusing steps, focus on throughput, which is sales revenue less direct materials, do not allocate operating expenses to products and use throughput per constraint unit as a major performance measure.

Key limitations of ABC and TOC

ABC is considered a long-term-oriented methodology that traces the cost of resources used in production to products (Holmen, 1995; Kaplan, 1989). ABC assumes that almost all of the costs are variable, so costs change according to the output level. However, in the short run, there are many fixed costs such as the cost of labour, rent, equipment, etc. The company will incur these kinds of costs whether the product is produced or not. As a result, ABC may give wrong information about short-run decisions because of not reflecting the actual costs the company will incur in the short run (Kaplan, 1989).

On the other hand TOC has a short-run time horizon. In the short-run, the capacity of a plant is fixed, and this fixed capacity will create the bottlenecks. However, in the long run, management can have an effect on capacity. Labour and overhead costs will not necessarily be fixed all the time. The weakness of TOC is that it does not include these costs and may give wrong information in the profitability analysis.

Moreover, TOC requires far less data and effort than ABC. Although TOC is easier to implement and operate, it sometimes provides insufficient information to guide management decisions. One of the frequent questions asked by managers is whether ABC is worth the cost or whether the TOC approach will be sufficient. The managers may decide to produce unprofitable products if they make decisions solely based on TOC (Holmen, 1995; Kee, 1998).

As can be seen, TOC and ABC appear contradictory. But both have been shown to improve performance of businesses. As companies are always searching for ways to improve a business' operational and financial performance, the possibility of integrating TOC and ABC to reap the benefits of each is attractive.

The rational for integrating ABC and TOC

ABC is a long-term tool because it assumes all costs are variable and TOC is a short-term tool because it assumes everything except direct materials is fixed. Both have different assumptions about labour and overhead costs and production capacity. These assumptions are valid depending on the time horizon. In the short run, labor and overhead costs and capacity can be considered as fixed. Under these circumstances, TOC can give the right information. However, in the long run, all costs tend to be variable and the capacity of a plant can be either increased or decreased depending on the level of demand. Since the assumptions of ABC are long-term oriented, it can reflect the expected costs of a company correctly in this time frame (Kee, 1998).

Sheu *et al.* (2003) recommended that managers should blend ABC and TOC approaches to benefit from the strength of both systems to accomplish improved decision making. Fritzsch (1997) tried to answer the question "whose right?" and concluded that these approaches are not mutually exclusive but rather represent pieces of a general approach to problem solving. Zadeh (1998) stated that companies adopting

ABC as a decision-making tool should be aware of its drawbacks, and argued that these drawbacks can be addressed by integrating ABC and TOC.

Given the above arguments about combining ABC and TOC and the promising results, along with the fact they are valid in different time horizons, the integration of them would capitalise on the strengths of each tool. The weaknesses of one approach can be overcome by the strengths of the other.

4. Methodology

Methodology is defined as the overall approach to the problem which could be put into practice in a research process from the theoretical underpinning to the collection and analysis of data (Remenyi *et al.*, 2003). Saunders *et al.* (2009) defined research strategy as "the general plan of how the researcher will go about answering the research questions".

Experiment, survey, case study, action research, grounded theory, ethnography, archival research, cross-sectional studies, longitudinal studies and participative enquiry are the main research strategies used in business and management. (Easterby-Smith *et al.*, 2008; Collis and Hussey, 2009). Case study research strategy is capable of accommodating different research techniques and is normally used when it is required to obtain in-depth knowledge with regard to a particular phenomenon. Moreover, it can accommodate both qualitative and quantitative data allowing the researcher to get a rich mix of data for the study (Yin, 2003; Gerring, 2007). In order to test the postulations of the study framework presented, the study proposes the following general research question:

RQ1. How can an integrated ABC and TOC approach enhance decision making in a Lean context?

To be able to develop an answer for this research question and test the validity of the suggested approach, a case study is conducted on one company called XYZ Company.

The case company

The XYZ Company (the managers of the company wished for their company name to remain anonymous in the study) has been established in the UK in the beginning of the 1970s of the last century and has a long-standing reputation for quality of products. XYZ is an injection and blow moulder company that produces a range of plastic containers as well as some specialised technical mouldings for a variety of industries like automotive, leisure, food and hospitals. The company has witnessed moderate growth during its 40-years existence. The increase in the number of production lines over years has been supported by increasing the number of machines and workstations. Moreover, the company has increased the number of operators and material handlers involved in the production process.

The company has suffered from lack of space, shortage of money to hold inventory and increase of market demand for high variety-small number of products which made mass production unjustifiable. As a result, XYZ Company decided to implement Lean manufacturing principles in 2007 by working on a make-to-order basis where customer orders trigger the production, reducing set up and lead time, holding around zero-level inventory of finished goods and producing one batch size of every product.

Before carrying out the field study, XYZ Company was using a traditional cost system, where overhead was allocated to products based on direct labour hours.

This cost information was then used principally for cost controlling, profit planning and manufacturing decisions. The managers of the company were concerned in determining reliable cost information for their major product lines. They welcomed the researchers' idea to carry out an action research to determine reliable cost information for their main products to enhance product mix decision and other relevant decisions.

Data collecting methods

The data collection process included conducting several interviews with the XYZ Company top management, shop floor supervisors, comptroller and accounting team. These interviews provided an understanding of the company's process mapping and the current accounting system as shown in Figure 1. Also, the company archival data were reviewed. The next step then involved an analysis of the company's manufacturing system, its constraints and the computations of a unit cost. This data collection process aimed at developing a beneficial data set that is able to provide suitable foundation for the rest of the action research.

Field study approach

Now that the rationale for blending ABC and TOC has been demonstrated, the next step is to develop an integrated ABC and TOC approach that is applicable for the Lean companies in particular throughout a field study. The goal of this field study is to present the developed approach to find a profitable product-mix. The next described six-step implementation approach has been developed by the authors, and following each step, the application of each step on the XYZ Company is given in further detail.

Step 1: investigate the company current financial records. The XYZ Company produces six main general-use containers, C1, C2, C3, C4, C5 and C6. The selling prices, demands, batch sizes, materials and direct labour costs of each product for the year 2011 are given in Table I.

Step 2: identifying cost pools and drivers. In this step, the cost pools and cost drivers are identified through interviews and an analysis of the accounting records together with all types of supporting documents. In this step, only key activities that are most important and highly related to indirect resource consumption were identified.

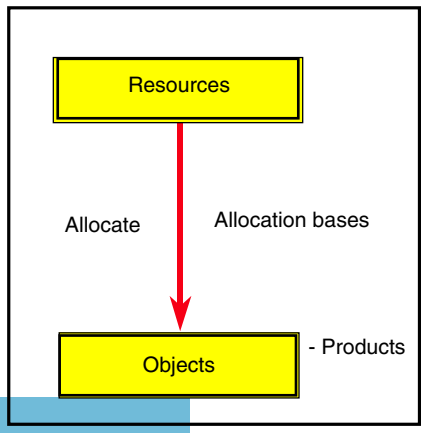

Figure 1.
Current cost process map

The XYZ Company performs nine key overhead activities to produce these products. The breakdown shown in Table II was the result of this step.

Step 3: assignment of overhead costs to cost pools. Once the cost pools have been identified, indirect overhead must be assigned to these cost pools according to the rate in which their associated activities consume these resources. This has been achieved through surveys and interviews with the key personnel of the company and tabulated in Table III.

Step 4: tracing cost to activities. In this step costs are traced to activities, it also consumed most of the time of the action research as the analysis depended on the records available, expert judgment and observation of activities. The results of this step are shown in Table IV.

Step 5: identifying constraints. Constraints are factors that limit achieving a certain desired goal (Tioanda *et al.*, 1999). The constraint can be capacity. One can change/

Table I.
The selling prices, demands, batch sizes, materials and direct labour costs for the year 2011

	Product C1	Product C2	Product C3	Product C4	Product C5	Product C6
Demand	10,800	27,000	18,000	7,200	5,400	8,000
Batch size	1	1	1	1	1	1
Material cost per unit (£)	0.12	0.12	0.12	0.18	0.24	0.48
Direct labour cost per unit (£)	0.30	0.54	0.78	1.0	1.25	2.98
Selling price (£)	2.5	4.5	3.5	4.5	3.5	4.0

Table II.
Cost pools and cost drivers

Cost pool	Cost driver
Machines	Number of machine working hours
Maintenance	Number of machine working hours
Product change over	Number of set-up labour hours
Raw material receiving	Number of invoices
Material handling	Number of moves
Production planning and controlling	Number of production runs
Product shipment	Distance in miles
Customer service	Number of customer contacts
Vendor relations	Number of vendors

Table III.
Overhead costs assigned to cost pools

Cost pool	Overhead cost (£)
Machines	30,276
Maintenance	16,965
Product changeover	8,273
Raw material receiving	23,175
Material handling	19,569
Production planning and controlling	29,621
Product shipment	8,603
Customer service	21,333
Vendor relations	22,118

Cost pool	Annual practical capacity	Charge rate (in £'s)
Machines	1,164 machine hours	26/machine hour
Maintenance	3,393 machine hours	5/machine hour
Product changeover	752 set up hours	11/set up hour
Raw material receiving	828 invoices	28/invoice
Material handling	1,398 moves	14/move
Production planning and controlling	1,058 production runs	28/production run
Product shipment	36 shipments	238/shipment
Customer service	435 contacts	49/contact
Vendor relations	98 vendors	225/vendor

Table IV.
Tracing costs to activities

increase the level of the existing resources supply of the constraining activity and hence the capacity limit. For the XYZ Company, the maintenance, production planning and controlling and product change over activities are performed by the machine hour activity. Therefore, these activities do not have their own capacity and their capacities are limited by the capacity of the production activity.

Identifying the capacities of activities such as customer service and vendor relations is more difficult. Last year, if 435 customer contacts were carried out, it would be difficult to argue that the capacity was less than these 435 customer contacts. On the other hand, it might be possible to argue that the capacity is much greater because there was unused capacity last year. Thus, using last years' experience, by the authors, as the capacity of these activities is considered a convenient approach. The capacities of activities are given in Table V.

Step 6: developing an integrated TOC and ABC income statement. In this step an integrated TOC and ABC income statement has been developed. This statement measures XYZ Company's financial performance over the fiscal year 2011. Table VI shows how the statement gives a summary of how the company incurs its revenues and expenses through both operating and non-operating activities. It also shows the net profit or loss incurred for its main six products.

5. Results and analysis

The developed income statement shows that product C5 and product C6 are unprofitable at their current selling prices. Product C1 and product C5 are profitable while products C2 and C3 are quite profitable and could survive for any competitive price cuts if necessary. XYZ Company should investigate the market feasibility of

Cost pool	Annual practical capacity	Capacity
Machines	1,164	2,456
Maintenance	3,393	3,393
Product changeover	752	752
Raw material receiving	828	1,850
Material handling	1,398	1,398
Production planning and controlling	1,058	1,058
Product shipment	36	87
Customer service	435	435
Vendor relations	98	98

Table V.
Capacities and annual capacities for activities

Table VI.
An integrated TOC and ABC income statement

	Capacity	Unused capacity	C1	C2	C3	C4	C5	C6	Used capacity
Sales (in units)	–	–	10,800	27,000	18,000	7,200	5,400	8,000	–
Revenues	537,800		270,000	121,500	63,000	32,400	18,900	32,000	537,800
Direct material	24,792		12,960	3,240	2,160	1,296	1,296	3,840	24,792
Throughput	513,008		257,040	118,260	60,840	31,104	17,604	28,160	513,008
Labour	99,766	41,174	33,056	14,606	14,094	7,329	6,765	23,916	140,940
Machines	63,856	33,589	4,843	1,987	3,129	2,708	5,264	12,345	30,267
Maintenance	16,965	–	4,132	754	497	1,991	3,456	6,135	16,965
Product changeover	8,273	–	1,045	352	434	995	1,225	4,222	8,273
Raw material receiving	51,800	28,625	3,205	950	1,060	2,408	3,322	12,230	23,175
Material handling	19,569	–	2,320	1,233	1,457	1,370	4,289	8,900	19,569
Production planning and controlling	29,621	–	7,651	2,440	2,400	4,132	2,319	10,679	29,621
Product shipment	20,706	12,103	2,280	635	680	1,250	1,313	2,445	8,603
Customer service	21,333	–	6,123	1,405	678	3,975	2,009	7,143	21,333
Vendor relations	22,118	–	5,443	790	1,328	4,567	3,130	6,860	22,118
Operating expenses			37,042	10,546	11,663	23,396	26,327	70,959	
Pretax income			219,998	107,714	49,177	7,708	8,723	42,799	

increasing the selling prices of the C5 and C6 products in conjunction with reducing the overhead resource consumption of these products. Moreover, the investigation of the income statement revealed that some activities had significant unused capacities. This confirms the fact that the XYZ Company is an unconstrained enterprise as a result of adopting Lean manufacturing techniques, but the company still needs to exploit unused capacities. The authors realised, during the action research, that in order to increase throughput and profits, the company would have to increase the capacity of the "soft activities" such as: customer service and vendor relations, by hiring a person who could work in both activities.

The implementation of the proposed approach revealed that using the current cost accounting system by the XYZ Company gives misleading information about the profitability of products and may result in poor decisions about the optimal product-mix and bottlenecks.

6. Conclusion

In a Lean context, traditional cost accounting methods fail in providing accurate, timely and reliable information to managers in order to make decisions about pricing, production line development, process improvements and product-mix. Each company has its own capacity and capability in producing several products but is uncertain what products and quantities it should produce in order to become more profitable. In this paper, a case study illustrates why a Lean company needs accurate cost information to make strategic decisions and how the proposed approach helps fulfill this need. Through the systematic use of the integrated ABC and TOC approach, the case company has been found producing mispriced products. Underpricing is as bad as overpricing because if a company is selling overpriced products it will likely not to be competitive and it might lose its business, and if the company is selling underpriced products it will lose money. The analysis showed that two main products have a negative net income per unit. The researchers urged the company to consider raising the price or further improving the process.

The integrated ABC and TOC approach is very promising as it allows managers of Lean companies to produce the right product-mix and run their companies more effectively. To excel in the current aggressive and very competitive marketplace; company resources must be utilised as efficiently as possible and the right product-mix is critical for the best utilisation of resources. This paper is new evidence that ABC and TOC should not be viewed as mutual exclusive approaches but can be used in a complementary manner to determine the right product-mix and offer a decided competitive advantage for Lean companies. Moreover, managers can use the integrated approach for strategic decision making, including controlling costs and developing more profitable business strategies.

Contribution of the study

The paper contributes to Lean and management accounting literature as it presents a relatively new decision-making approach better suited to supporting Lean initiatives. Also a case study is chosen for the empirical aspect of the study as there are no case studies available in the literature that illustrate a real life case of integrating ABC and TOC within Lean companies as an alternative to the current used cost accounting systems. The proposed approach has the potential to help Lean companies in determining their optimum product-mix and improve their financial performance

Limitations, obstacles and future research

Although case study as a research method has various advantages, in that it presents data of real-life situations and provides better insights into the detailed behaviours of the subjects of interest, caution must be exercised in generalising the results presented as the paper is based on a single case study with an action research approach.

It should be no surprise that the first thing faced the authors in the action research case study is the resistance to change. Although, the company executives dedicated all resources and showed boundless commitment to the idea, some proponents were trying to abolish the fame and validity of the proposed approach under the pretext of being expensive and inefficient. A good solution to tackle this issue was presenting similar successful experiences by other leading companies, simplifying the work required to set up the approach and make its implementation more feasible for their company. Future research could start from replicating the proposed approach in other Lean companies to validate and confirm the proposed approach.

Managerial implications and lessons learned from the case study

As per the discussed literature, the implementation of lean manufacturing is highly recommended for companies to meet the increasing competitive pressures. Consequently, Lean companies, having a condition of shared resources, get into financial troubles not because of bad products or services, but because they lack appropriate cost accounting systems.

The results of the case study suggests that the integration of ABC and TOC provides managers with an accurate, timely, and reliable tool that can help in making decisions about pricing, production line development, process improvements and product mix. It demonstrates to managers how they can determine their optimum product mix and improve their financial performance.

Last but not least, it is worthy to mention some lessons learned by the authors during the case study journey which can help in a proper implementation of the integrated ABC and TOC approach:

- get senior management buy-in for the change initiative;
- establish a clear timetable for completion of the initiative;
- use the ABC-TOC integration as an on-going process rather than a model;
- avoid making the initiative a self-serving project with no involvement from other department; and
- market the ABC-TOC integration as a valuable tool rather than an end-all solution.

References

Anderson, S.W. (1995), "A framework for assessing cost management system changes: the case of activity based costing implementation at General Motors, 1986-1993", *Journal of Management Accounting Research*, Vol. 7, Fall, pp. 1-51.

Bhatia, N. and Drew, J. (2007), "Applying lean production to the public sector", *The McKinsey Quarterly: The Online Journal of McKinsey & Co*, Vol. 13, pp. 97-110.

Carnes, K. and Hedin, S. (2005), "Accounting for lean manufacturing: another missed opportunity?", *Management Accounting Quarterly*, Vol. 7 No. 1, pp. 28-35.

Collis, J. and Hussey, R. (2009), *Business Research: A Practical Guide for Undergraduate and Postgraduate Students*, 3rd ed., Palgrave Macmillan, New York, NY.

Cooper, R. (1994), "The role of activity based systems in supporting the transition to the lean enterprise", *Advances in Management Accounting*, Vol. 3, pp. 1-24.

Cooper, R. and Kaplan, R.S. (1988), "Measure costs right: make the right decisions", *Harvard Business Review*, September-October, pp. 96-103.

Cooper, R. and Kaplan, R.S. (1992), "Activity-based systems: measuring the costs of resource usage", *Accounting Horizons,* September, pp. 1-13.

Corbett, S. (2007), "Beyond manufacturing: the evolution of lean production", *The McKinsey Quarterly*, Vol. 3, pp. 95-105.

Dahlgaard, J.J. and Dahlgaard-Park, S.M. (2006), "Lean production, Six Sigma quality", *TQM and Company Culture, TQM Magazine*, Vol. 18 No. 3, pp. 263-281.

Drury, C. (2006), *Management Accounting For Business*, 3rd ed., Thomson Learning, London.

Easterby-Smith, M., Thorpe, R. and Jackson, P.R. (2008), *Management Research*, 3rd ed., SAGE Publications, London.

Fritzsch, R.B. (1997), "Activity-based costing and the theory of constraints: using time horizons to resolve two alternative concepts of product costs", *Journal of Applied Business Research*, Vol. 14 No. 1, pp. 83-89.

Fu, A. (2000), "Theory of constraints and activity based costing: can we get the best of both worlds?", *Business Review*, Vol. 2 No. 2, pp. 67-74.

Fullerton, R. and Kennedy, F.A. (2009), "Modeling a management accounting system for lean manufacturing firms", *Social Science Research Network*, available at: http://ssrn.com/abstract=1445703 (accessed 20 July 2012).

Fullerton, R. and Wempe, W. (2008), "Lean manufacturing, non-financial performance measures, and financial performance", *International Journal of Operations & Production Management*, Vol. 29 No. 3, pp. 214-240.

Fullerton, R.R. and McWatters, C.S. (2004), "An empirical examination of cost accounting practices", *Advances in Management Accounting*, Vol. 12 No. 3, pp. 85-113.

Gerring, J. (2007), *Case Study Research: Principles and Practices*, Cambridge University Press, Cambridge.

Goldratt, E.M. and Cox, J. (1992), *The Goal*, 2nd Revised ed., North River Press, New York, NY.

Grasso, L.P. (2005), "Are ABC and RCA accounting systems compatible with lean management?", *Management Accounting Quarterly*, Vol. 7 No. 1, pp. 12-27.

Gupta, M. and Kline, J. (2008), "Managing a community mental health agency: a theory of constraints based framework", *Total Quality Management & Business Excellence*, Vol. 19 No. 3, pp. 281-294.

Gupta, M., Chahal, H., Kaur, G. and Sharma, R. (2010), "Improving the weakest link: a TOC-based framework for small businesses", *Total Quality Management & Business Excellence*, Vol. 21 No. 8, pp. 863-883.

Holmen, J.S. (1995), "ABC vs TOC: it's a matter of time", *Management Accounting*, Vol. 76, pp. 37-40.

Kaplan, R.S. (1983), "Measuring manufacturing performance: a new challenge for managerial accounting research", *The Accounting Review*, Vol. 58 No. 4, pp. 686-705.

Kaplan, R.S. (1989), "Introduction to activity based costing", *NAA Conference, Global Solutions to Global Problems II, Boston, MA, March 30-31*, pp. 32-43.

Kee, R. (1998), "Integrating ABC and the theory of constraints to evaluate outsourcing decisions", *Journal of Cost Management*, Vol. 12 No. 1, pp. 24-36.

Matthews, J., Pellew, L., Phua, F. and Rowlinson, S. (2000), "Quality relationships: partnering in the construction supply chain", *International Journal of Quality & Reliability Management*, Vol. 17 Nos 4/5, pp. 493-510.

Raffish, N. and Turney, P. (1991), *The CAM-I Glossary of Activity Based Management*, in B.B. (Ed.), Consortium for Advanced Manufacturing-International, Arlington, TX, pp. 53-63.

Remenyi, D., Williams, B., Money, A. and Swartz, E. (2003), *Doing Research in Business and Management: An Introduction to Process and Method*, SAGE Publications, London.

Saunders, M., Lewis, P. and Thornhill, A. (2009), *Research Methods for Business Students*, 5th ed., Pearson Education, Harlow.

Sheu, C., Chen, M. and Kovar, S. (2003), "Integrating ABC and TOC for better manufacturing decision making", *Integrated Manufacturing Systems*, Vol. 14 No. 5, pp. 433-441.

Tioanda, P., Whitman, L. and Malzhan, D. (1999), "Determine product mix using ABC and TOC", *Proceedings of The 4th Annual International Conference on Industrial Engineering Theory, Applications and Practice, San Antonio, Texas, November*, pp. 17-20.

Womak, J. and Jones, D. (1996), *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*, Simon & Shuster, New York, NY.

Yin, R.K. (2003), *Case Study Research: Design and Methods*, 3rd ed., SAGE Publications, London.

Zadeh, Y.M. (1998), "Product-mix decisions under activity-based costing with resource constraints and non-proportional activity costs", *Journal of Applied Business Research*, Vol. 14 No. 4, pp. 39-46.

Zadry, H.R. and Yusof, S.M. (2006), "Total quality management and theory of constraints implementation in Malaysian automotive suppliers: a survey result", *Total Quality Management & Business Excellence*, Vol. 17 No. 8, pp. 999-1020.

Further reading

Womack, J.P., Jones, D.T. and Roos, D. (1990), *The Machine that Changed the World*, Rawson Associates, New York, NY.

About the authors

Dr Majed Alsmadi is currently an Industrial Practitioner and Part-Time Lecturer. He received his PhD Degree in Industrial Engineering and Operations Management from Coventry University UK, MBA/Production and Operations Management from the Hashemite University, Jordan and a BSc in Mechanical Engineering from the University of Jordan, Jordan. He has published refereed and conference papers in the area of Lean, TQM, Six Sigma, continuous improvement, balanced scorecard, competitive advantage and business excellence. His work experience besides the academia includes 22 years in the manufacturing sector as maintenance engineer, quality/reliability manager, production planning and controlling manager, also Dr Alsmadi is a certified PMP and Six Sigma Black Belt. Dr Majed Alsmadi is the corresponding author and can be contacted at: majedjor@yahoo.com

Dr Ahmad Almani is an Assistant Professor of Business Administration at the Faculty of Business Administration in the Philadelphia University. His research interests are in the area of business strategy, Lean production and change management.

Dr Zulfiqar Khan is a Senior Lecturer at the Coventry Business School, in the Department of Strategy and Applied Management. His primary research interests are in the areas of logistics, business management, SME competitiveness and supply chain management.