Back to norms: Can Activity-Based Costing be the right answer to the 'appropriate' question?

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Abstract

In 2006, Johnson published his famous paper; *"lean accounting: to become lean shed accounting"*. The paper explained the logics behind a lean management system and how traditional accounting practices, especially costing ones, such as standard costing and activity-based costing (ABC) fail to fit an operation and management system built around lean principles. Johnson (2006) discussed how ABC can be the right answer to the wrong the question, identifying that a question of cost and/ resource allocation would not normally be correct for lean firms focusing on operations' flow. As much as the paper was right on how some costing practices, for example standard costing, comes in contrast to some of the main of objectives of a lean management system, the paper tends to presume an almost standardized way in which organisations approach lean management implementation, including how operation flow is managed and how value streams are identified. This paper seeks to understand different patterns in which organisations manage the flow of their operations, identify their value stream/s and how this is then reflected on the type of demand/ questions they have regarding their costing needs. Based on this understanding, the paper suggests that ABC can sometimes become the right answer to an 'appropriate' question which we have not yet explored. An 'appropriate' question that is mainly driven by lean organisations' specific needs and the pattern in which they have structured and managed their lean management implementation. The paper sets a framework which succeeds to integrate Activity-Based Costing in one of the factories of a Swiss multinational organisation manufacturing power components. The suggested ABC framework is used to compute organisation's product costs and make other decisions on its value adding and non-value activities. The paper responds to various calls to conduct context driven management accounting research and in-depth case studies which explores different management accounting practices to work with lean management. Findings of the paper contributes to both management accounting and lean management literature through explaining how ABC can still have an influential role in lean firms, especially when other lean accounting costing practices – such as value stream costing – cannot suffice organisations' needs.

Keywords,

Activity-Based Costing (ABC), Management Accounting Practices, Lean Management, Lean Accounting.

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1. Introduction

Increasing global competition has raised customers' expectations of more heterogeneous product choices to be offered to them at high quality level, low prices and reasonable delivery times. That is why companies now seek the movement to a more customer focused operating system as Lean Management to be able to sustain a good competitive position (Kennedy and Widener, 2008; Fullerton et al., 2013; Fullerton et al., 2014; Tillema and van der Steen, 2015). This study suggests that a good competitive position requires the cooperation of both the company's operating and accounting systems. This explains the evolvement of the "Lean Accounting System"; the accounting system used by lean manufacturing firms (Maskell and Bagalley, 2004). In order to avoid the drawbacks of the traditional costing system when used in a lean manufacturing environment and to provide relevant lean tailored accounting information (Maskell and Baggaley, 2004; Fullerton et al. 2013; van der Steen and Tillema , 2018).

For costing purposes, the lean accounting system proposes the use of Value Stream Costing (VSC). Using value stream costing, all costs incurred to produce a product – from the receipt of a sales order till order shipment – are directly traced to a production value stream (Kennedy and Brewer, 2006, Tillema and van der Steen, 2015; van der Steen and Tillema; 2018). However, the effective implementation of VSC requires the presence of certain conditions. Most of which revolve around the necessity to eliminate the sharing of production resources and the overlap of human capital (Maskell and Baggaely, 2004). The inability to achieve such condition to effective implementation of VSC may obstacle the VSC approach to provide reliable accurate product unit costs. Ward and Graves (2004) confirm to this idea stating that for lean companies producing a variety of products where resources are interrelated, an overhead allocation problem may occur.

This study mainly focuses on the role of the accounting system in providing accurate product unit costs to help companies enhance their competitive position. The study

presents a framework that suggests the use of Activity-Based Costing (ABC) as an overhead allocation method in lean firms in which production resources are still shared. The purpose and primary aim of this study is to test the effect of implementing ABC in lean firms on achieving accurate product unit costs given a condition of shared resources. This study also investigates the effect of computing product unit costs using ABC on the competitive position of the lean manufacturing firm. This is done through conducting a case study on one of the factories of a multinational company operating in Egypt which has recently moved to lean manufacturing.

The study contributes management accounting and lean management literatures calling for more in-depth case studies on the management accounting practices to work with lean management (Tillema and van der Steen, 2015, Fullerton et al., 2013; Rao and Bargerstock, 2011). The study also, responds to various claims on how management accounting literature lags behind lean transformation (Carnes and Hedin, 2005; Moore and Scheinkopf, 1998). A case study is chosen for the empirical study as there are very few case studies available in the management accounting literature that discuss a real life case of integrating common management accounting tools – like the ABC – within lean firms and to supplement a lean accounting system (Carnes and Hedin, 2005).

The following section (Section 2) discusses the background literature on ABC, lean manufacturing and lean accounting systems. Section 3 presents the study theoretical framework for ABC implementation, provides a summary of the study research questions and details the research methodology used as well as the data collection process. Section 4 discusses the implementation of the framework analyzing the results found and their implications. Finally, a summary and conclusion to the study is presented in Section 5.

2. Literature Review

2.1 Activity-Based Costing and Product Cost Development

To all management and cost accounting professionals and academics, product/service costing means; “computing all the costs related to a certain product or service for a specific purpose” (Horngren et al., 2005). Traditionally, it faces no problems in dealing

with direct costs yet, the problem has always been with the allocation of indirect/overhead costs. Specially in today's automated industries which placed more emphasis on the importance of accurate overhead allocation in achieving accurate product unit costs (Reyhanoglu, 2004). This is what lead Cooper and Kaplan to develop the Activity-Based Costing (ABC) method early in 1980's (Geri and Ronen, 2005; Grasso, 2005; Draman et al., 2002; Kennedy and Graves, 2001).

Also to meet the drawbacks of the traditional overhead allocation method in terms of; imprecisely linking all overhead costs to only one cost driver to which they are not always related (Tsai, 1998; Kroll, 2004; Reyhanoglu, 2004; Ward and Graves, 2004). In addition to creating biased/cross-subsidized product costs through overpricing high-volume simple products and under-pricing low-volume, complex ones (Horngren et al., 2005; Cardinaels et al., 2004; Reyhanoglu, 2004; Chan and Lee, 2003). All of these drawbacks have eventually lead to a lot of costing distortions initiating the need for ABC.

According to Narong (2009) Activity-Based Costing (ABC) is an approach that assigns costs in an objective way through the "cost and effect relationships" in which each activity cost is identified and assigned to each product or service only if such product or service utilizes the activity. The application of ABC has lead to computing more accurate and reliable product unit costs. This motivates managers to depend on their accurate costs not only to take better short term decisions but also better long term strategic ones that affect product design and product processing activities (Geri and Ronen, 2005). The ABC system helps firms filter out the biased prices of their competitors and thereby they can take more reliable pricing and product mix decisions (Cardinaels et al., 2004). Grasso (2005) also mentioned that U.S. firms that adopted the ABC system reported that it seriously affected their profitability levels and competitive stand.

On the other hand, even though academics, management accountants and ABC adopters comment on how advantageous the ABC is, its rate of implementation is still low compared to that of the traditional costing allocation method (Askarany et al., 2007; Geri and Ronen, 2005; Kennedy and Graves, 2001). The reasons behind this include the

belief of some managers that the benefits achieved from implementing an ABC system do not outweigh the costs to establish the system (Reyhanoglu, 2004; Dearman and Shields, 2001). In addition to the technical and strategic support needed for ABC implementation in order to refine the resistance to change problems from both accountants and line workers (Grasso, 2005; Kennedy and Graves, 2001).

However, a recent study by Stratton et al. (2009) showed that the use of ABC as a costing tool is still relevant among its adopters. Even managers of non ABC firms desire the implementation of ABC and consider it an ideal costing tool. The study also mentioned that such desirability and consideration of ABC projects an expected increase in ABC adoption in the future too.

Actually, the role played by the accounting system in providing accurate product unit costs through the use of a management and cost accounting tool as the ABC is sought to result in achieving better competitive positions for companies. At the same time, for a management and cost accounting tool to help a company achieve a better competitive position, this accounting tool shall be implemented in an effective operating system that also enhances the company's competitive stand. However, this was not the case with companies adopting a mass production operating system.

Accordingly to Kennedy and Brewer (2006) the main goal of the mass production system is to achieve the lowest possible product cost through gaining the benefits of using the economies of scale. Such cost leadership strategy made accounting tools the key to achieve the mass production system's goal. This implies that all efforts are made to achieve the lowest possible cost especially that of the allocated overhead cost.

Thinking this way derived manufacturers to adopt certain behaviors including; overproduction, clustering of functional machinery, departments and working teams, creating a "push" production system as well as keeping short term suppliers' relationships. However, such behaviors were actually found to result in wasted resources, creating a lot of non value adding service departments as well as receiving low quality or

late delivery supplied components and eventually less satisfied customers (Kennedy and Brewer, 2006).

More importantly all of these consequences act against the achievement of a good competitive position for the company and do not aid managerial and cost accounting tools to reach such good competitive stand too. This highlights that in today's growing competitive market, suggestions are that companies shall consider changing their manufacturing system to a more customer focused one such as "Lean Manufacturing" before applying any supplementary management accounting tool (Grasso, 2005).

2.2 The Lean Manufacturing and Lean Accounting Systems

Owing to some productivity downturns and the severe competition that Toyota Motor Corporation faced during the period from 1930's till mid 1960's, that the company discovered the myths behind the mass production system (Shimokawa and Fujimoto, 2009). That is why Toyota and the Japanese industry were able to sustain high competitive position and high levels of profitability due to changing their operating systems to what is now known as a "Lean Manufacturing" system (Grasso, 2005).

The lean manufacturing system is defined according to two perspectives, the first one views lean as a way of "thinking" or more of a philosophy. This perspective defines what lean manufacturing in concept is. The other perspective views lean as a "tool box" and this perspective is concerned with defining the practices that help in sustaining a lean manufacturing system (Pettersen, 2009). Shah and Ward (2003) mentioned that literature discussing lean as a philosophy often defines it as**; "**a philosophy that focuses on avoiding seven cardinal wastes and on respecting customers, employees and suppliers". Grasso (2005) elaborates these "seven cardinal wastes" as; Overproduction, Waiting, Transportation, Processing, Inventory, Motion and Defects. From a "tool box" view point; Shah and Ward (2003) as well as Pettersen (2009) mentioned a set of practices which form the most frequently discussed practices used in a lean manufacturing system. Such practices include JIT/continuous flow production, pull system, kanbans and quick

change over technique, continuous improvement, failure prevention and production leveling.

Accordingly, there are commonly shared practices that are used by most companies that apply lean manufacturing. On the other hand, even though there might be a conceptual definition of lean manufacturing which makes lean a separate concept identifiable from other concepts. There is no agreed upon definition that details which exact practices constitute the lean manufacturing system (Pettersen, 2009). At the same time, most of the commonly used lean practices stem from its five main principles, which are; the specification of customer value, identifying the value stream, keeping the flow of process, the pull principle and the perfection principle (Moore and Scheinkopf, 1998; Maskell and Baggaley, 2004).

Recently, a lot of companies have changed their production systems moving to a lean manufacturing system (Carnes and Hedin, 2005). According to Maskell and Kennedy (2007), fifty percent of American manufacturing companies are working to introduce lean manufacturing into their plants. This attributed to a lot of benefits including creating a better understanding of the business processes for labor workers, improving workers productivity skills and decreasing production cycle time and better matching customers delivery dates (Shah and Ward, 2003). In addition to receiving less defective supplied parts, meeting customer demands, turning out high quality products, saving costs through waste elimination and achieving higher profitability rates (Emiliani and Stec, 2005; Oliver et al., 2002).

However, there are still a lot of companies that have implemented lean and accomplished just modest improvements which are only related to operational activities. Some Managers report that they lack a lean implementation know-how and they face a lot of resistance to change problems in their way to implement lean (Emiliani and Stec, 2005). According to Hines et al. (2004) some lean adopters apply lean principles to operations only and neglect that it is a whole new culture that shall be extended to every aspect within the organization to work effectively. Companies also sometimes lose the main objective behind lean implementation and streamline their production using

standardized parts and dealing with the same suppliers for most of their products so as to achieve cost reductions. This eventually leads them to incur more costs in terms of either default products or sales cut off from recalling huge amounts of products as Toyota has recently did (Wakabayashi, 2010).

Almost all the discussed limitations facing lean implementation are mostly due to misconceptions of senior managers and manufacturers who fail to implement the philosophical approach to lean manufacturing. In addition to their failure to think outside the "tool box" view of lean thinking. Actually one of the main limitations to implementing lean that is not based on any misinterpretations is the one caused by the traditional costing system. This is because the traditional costing system is almost obsolete with respect to the current manufacturing innovations that are customer oriented, such as lean manufacturing (Gupta and Gunasekaran, 2005; Fullerton and Kennedy, 2009). Some companies cancel the idea of transforming to lean because they do not see so much financial benefits out of the transformation (Bhasin and Burcher, 2004; Maskell and Baggaley, 2004). Their traditional accounting system with its focus on variance analysis, inventory valuation and the traditional concept to overhead allocation, does not show financial benefits from lean nor does it provide relevant costing and financial information. On contrary, the traditional accounting system gives results that contradict the improvements achieved by lean manufacturing (Brosnohan, 2008; Crandall and Main, 2007). It even motivates various non lean behaviors that are grounded in the mass production system (Maskell and Baggaley, 2004). This is what lead to the evolvement of the new "Lean Accounting system".

A lean accounting system is "A new method of managing a business that is built upon lean principles and lean methods" (Kennedy and Widener 2008, Maskell and Baggaley 2004). Lean accounting is defined from two perspectives; (1) the accounting for lean and (2) the lean accounting. The accounting for lean perspective focuses on how the reported financial information shall support a lean manufacturing system (Grasso, 2005). While the lean accounting perspective deals with integrating the lean thinking in terms of focusing on the customer's value adding activities and eliminating wastes to the accounting system (Crandall and Main, 2007). From these two perspectives come the five

famous lean accounting principles. According to Maskell and Baggaley (2006) the fulfillment of the lean accounting principles requires the implementation of various practices including financial reporting, cost management, internal control and continuous improvement.

However since this paper focuses on the use of management and cost accounting tools to support lean companies improve their competitive stand, more concern is given to the lean accounting Value Stream Costing (VSC) method. VSC is defined as; "VSC is used to eliminate most of the wasteful transactions associated with production control, materials, and product costing. VSC eliminates the need for standard costing and overhead allocations and creates a simple and effective cost accounting method" (Maskell and Baggaley, 2004). Using VSC all costs incurred are assigned directly to the value stream[2] hence; most of these costs shall be considered direct costs that are easily traced to the value stream (Ward and Graves, 2004). If needed – a product cost can then be determined as the average cost of units manufactured and were actually shipped by a certain value stream during a given period of time (Kennedy and Brewer, 2006).

In fact, lean accounting advocates view the idea of computing an individual product unit cost as unnecessary for lean firms (Fullerton and Kennedy, 2009; Debusk, 2008). This is actually since in lean firms the focus is on the whole process. Therefore, various decisions can be made on basis of the whole value stream available capacity and profitability (Brosnahan, 2008). In the same sense, maintaining an effective control over inventory in a lean manufacturing system minimizes the need for computing product unit cost to be used in inventory valuation (Kroll, 2004).

Actually, this constitutes a vague part in the value stream costing postulations about the need for individual product unit costs. This is because lean accounting advocates also admit that product unit cost is still needed for transfer pricing decisions. Also, if customer orders cover a long production execution period that exceeds three months, then individual product unit cost will be needed for inventory valuation purposes (Maskell and

[2] "A value stream represents all activities and resources consumed from the time a customer order is received until the product is delivered to the customer." Kennedy and Brewer (2006)

Kennedy, 2007; Maskell and Baggaley, 2004). Such idea requires a more detailed information technique than the average product cost per unit developed by VSC and this detailed costing tool cannot always be the proposed lean accounting "Features and Characteristics costing" method. Since features and characteristics costing has its own share of criticism regarding its accuracy and validity concerns (Maskell and Kennedy, 2007). Also according to Maskell and Baggaley (2004) the effective implementation of VSC requires some conditions at the top of which is the necessity to eliminate both sharing of resources and the overlap of people.

However, fulfilling such conditions requires the establishment of almost a perfectly hundred percent lean tailored manufacturing environment. A state that is not always easy to attain at least in short to medium time intervals and specially for most developing countries such as Egypt. Since this requires a lot of efforts in value stream identification together with a lot of investments over equipment purchases and the development of cross training programs (Maskell and Baggaley, 2004). This explains why few companies have adopted the lean accounting practices since it requires full support from top management, perfectly trained and empowered workers and a lot of efforts in streamlining organizations management accounting systems. This all may hinder companies even from implementing lean manufacturing (Fullerton and Kennedy, 2009).

3. Research Methodology

As discussed in the previous review of literature, the conditions for effective implementation of VSC require almost perfect conditions of a lean manufacturing system. That is; developing a condition in which each value stream includes products that undergo the same production process and take the same processing time. This is in addition to eliminating any shared resources between the identified value streams as well. Those two conditions seek the elimination of the need for an overhead allocation method that allocates costs among value streams and considers how products in one value stream consume resources differently. As a result, this shall lead to less dependency on the use of features and characteristics costing and thereby avoiding the concerns related to its validity and accuracy.

However, as mentioned in the previous discussion, this is not always an easy condition to maintain and it may even lead some manufacturers to back off from implementing lean. Accordingly, instead of considering a status of shared resources as barrier to VSC implementation or to the movement to a lean manufacturing system, a more accurate allocation method may be needed. This idea is elaborated in the study proposed framework shown in Figure (1). Figure (1) shows that a condition of almost zero shared resources is needed in order to obtain reliable product unit costs using the value stream costing method.

When such condition is not attained an environment of shared resources is initiated which may require the use of an accurate overhead allocation method like the Activity-Based Costing (ABC) system. This is to resolve any problems that may occur due to the constraining conditions to implementing VSC with respect to product costing. This has the objective of developing more accurate product unit costs that support the company's accounting system to better reflect a customer-oriented operating system as lean manufacturing and eventually help enhance the company's competitive position.

In order to test the postulations of the study framework presented, the study proposes the following general research question:

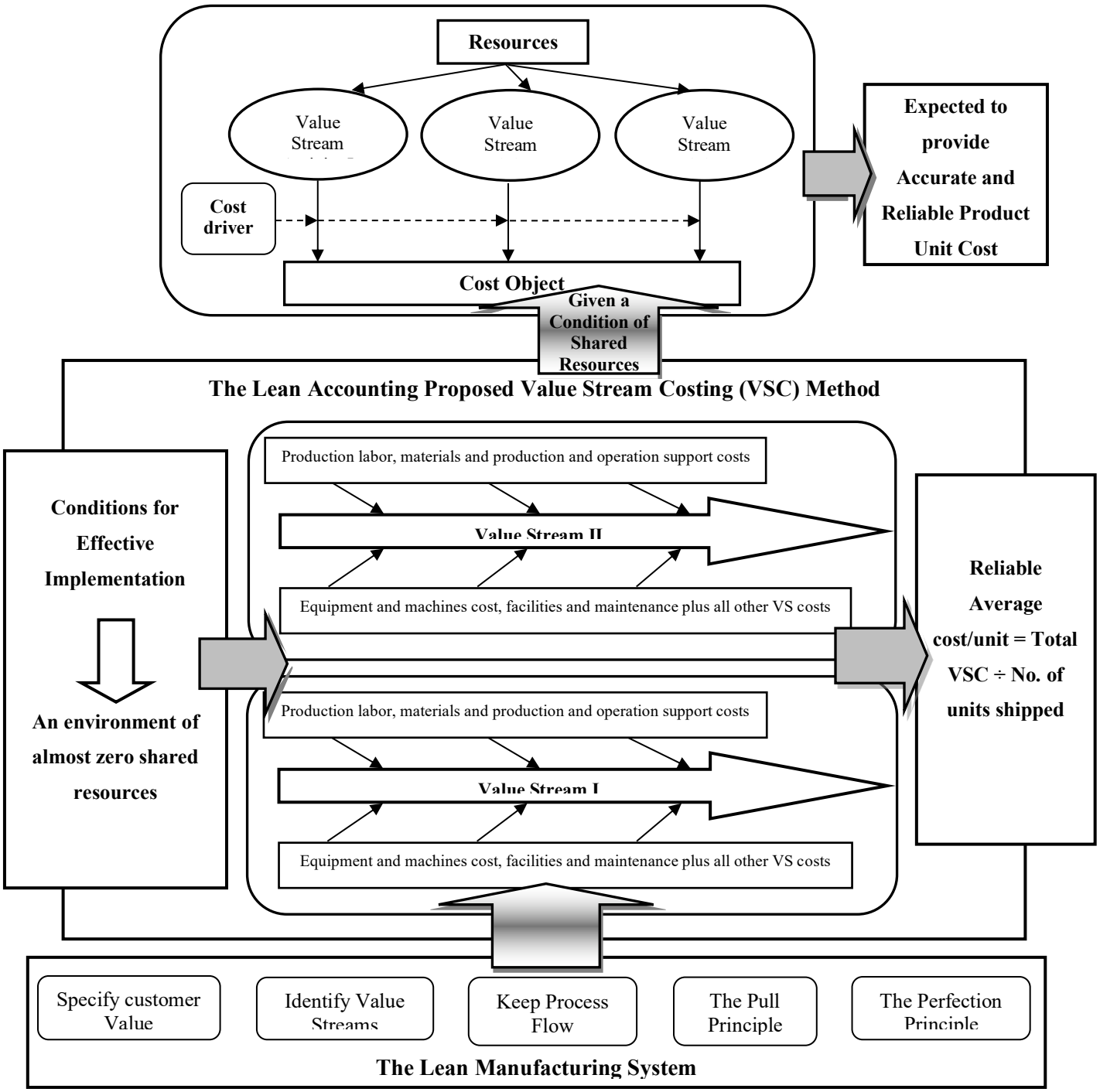
> ***"Can the Integration of Activity-Based Costing (ABC) in a lean environment help enhance the Company's competitive position given a condition of shared resources?"***

To be able to develop an answer for this research question, the following two sub-research questions are being investigated through the empirical of this study.

RQ 1: Does the integration of an ABC system in a lean company result in more accurate product unit cost given a condition of shared resources?

RQ 2: Does the integration of an ABC system in a lean company help enhance the company's competitive position?

Figure 1: Study Framework: Integrating ABC in a Lean Environment, given a Condition of Shared Resources.



To test the validity of the suggested framework postulations, a case study is conducted on one factory of a multinational Company operating in Egypt. The name of the Company is kept anonymous as per agreement with its management to keep it confidential. Consequently, the studied company is referred to as Company X. Company X is a leading multinational company for automation and supplying electrical power components. Its Egyptian branch started to supply its products to the Egyptian market at the beginning of the 1980's. The Company has six factories producing and assembling power components in Egypt. The case study is conducted on the Company's factory responsible for producing distribution transformers. This factory is chosen for conducting the study because it is the only manufacturing factory that has moved to lean manufacturing.

Company X Transformers factory was established during 1998 and is responsible for producing distribution transformers ranging from 50 Kilo-Volt-Ampere (KVA) to 5000 KVA. The factory is currently supplying the Egyptian and foreign markets with more than one thousand transformers per year and has a market share of 41%. Company X Egyptian Transformers factory has three competitors in the Egyptian market, for confidential reasons the three competitors are referred to as Companies A, B and C. The factory produces three main types of distribution transformers, small distribution transformers (SDT), medium distribution transformers (MDT) and large distribution transformers (LDT).

A case study was chosen in order to obtain real life figures of the company's product unit cost before and after the implementation of ABC. Also, according to Triest and El Shahat (2007), most of the western management accounting tools including ABC are found to be almost unknown for Egyptian accountants and manufacturers. That is why Triest and El Shahat (2007) suggest that it might be helpful to include a glossary in management accounting surveys elaborating the management accounting tools being used in the survey. Consequently, since the study tackles three commonly unfamiliar concepts to Egyptian firms - ABC, lean manufacturing and the lean accounting VSC method - conducting a survey that includes a glossary explaining the three concepts may

not be practical. It may also lead to misconceptions that affect the validity of the results obtained.

The data collection process takes three stages; the first stage includes conducting several periodic semi-structured interviews with the Transformers factory plant head. The second stage involves conducting other periodic semi-structured interviews with the chief accountant controller and Company X accounting controllers team. A final step then involves an analysis of the Company's manufacturing system, its computations of a transformer unit cost and the effect of implementing the study framework on product costing and on the company's competitive position.

This data collection process aims at developing a beneficial data set that is able to provide suitable answers for the study's research questions. The interviews with Company X Transformers factory head aim at providing an understanding of the factory's manufacturing process flow and whether the factory is advanced with lean manufacturing and is currently operating using the value streams or not. Such interviews also supplement information on the factory's current organization of value streams – if applied. This set of information is essential in answering research question one, as according to Maskell and Baggaley (2004) the application of VSC requires companies to be managing by value streams. Actually, the information collected in this phase formed one of the reasons why Company X specifically was chosen for this study. This is because its Transformers factory has implemented lean manufacturing since 2004 and is currently operating using the value stream processing approach. Subsequent interviews with the Company's chief accounting controller and its accounting controllers team are then essential to gain an understanding of the factory's cost categories prior to applying the VSC method as suggested by the first research question.

Understanding of the factory's production process through the factory's head interviews is also essential for setting potential cost drivers for applying ABC as required by the second research question. Substantial information on the factory's costs and how the company computes its cost per transformer is then needed to deduce a before and after analysis of the application of ABC. That is why interviewing the Company's

accounting controller and accounting team is conducted to supply with information on this scope.

Above all, an understanding of the factory's value streams and current production process is essential in answering the study's two research questions. As such understanding provides information on the degree of shared resources between the factory's identified value streams and among products produced by the same value stream as well. Finally, analyzing the effect of implementing the study's framework in contrast with the company's current costing system is then required to obtain insights on the effect of ABC application on the company's competitive position. This analysis provides answers to the study's third research question.

4. Findings and Analysis

A content analysis of the interviews with both the factory's head and the Company's accounting controllers is conducted. Interviews data collected are then transcribed and analyzed. Analysis of data collected is categorized into manufacturing data analysis and costing data analysis. These two sets of analyzed data collected results in subsequent conclusions that support the implementation of the study suggested framework as will be discussed.

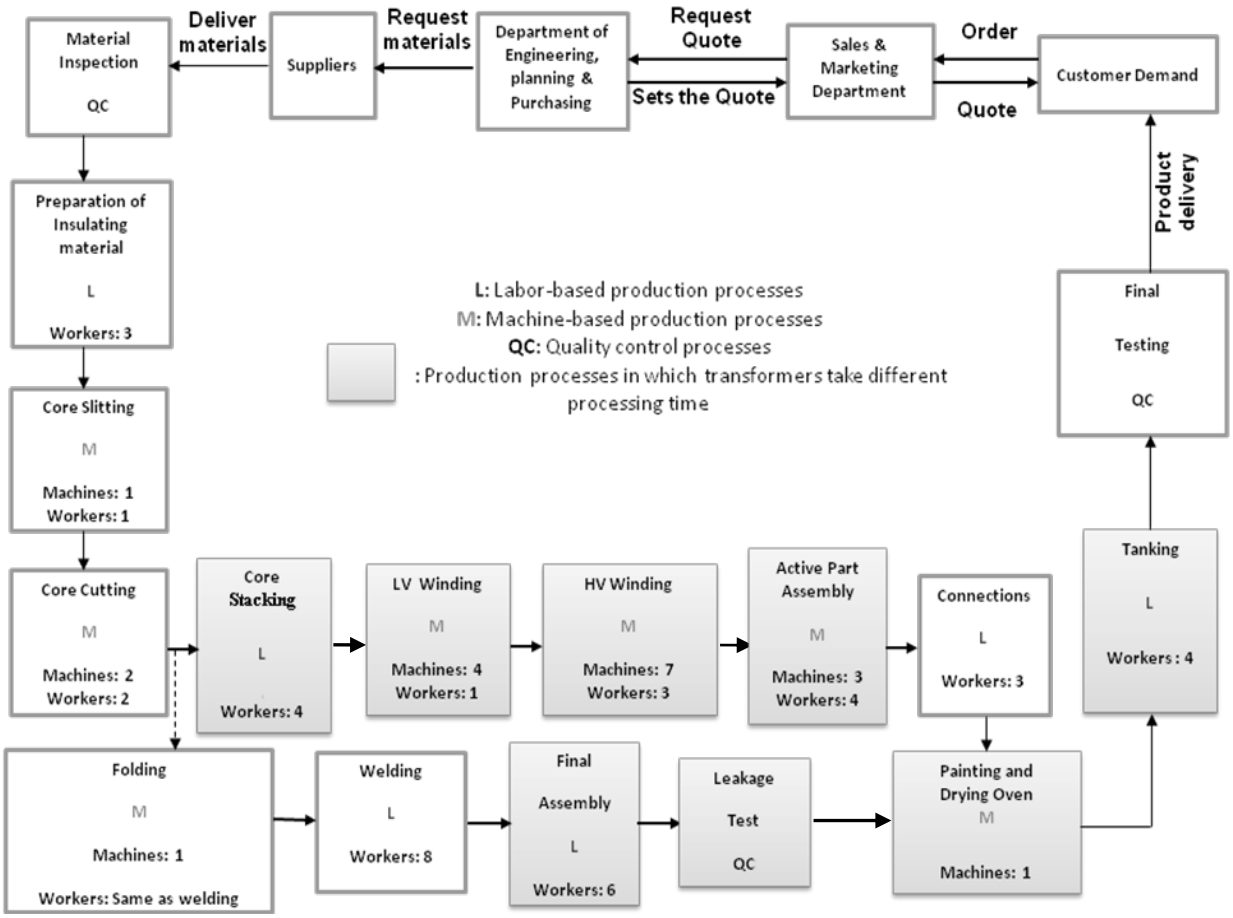
4.1 Manufacturing Data Analysis

In this phase the factory's manufacturing data are being analyzed to investigate whether the current manufacturing status leads to the creation of a condition of shared resources or not. The value stream map for Company X Transformers factory is illustrated in Figure (2). The process starts at the receipt of a customer order by the sales and marketing department. The engineering, planning and purchasing department develops the design of the order, sets its quotation and requests materials needed from suppliers. All materials shall be inspected before they go into production.

The production process includes the production of the transformers' main component parts and the production of transformers tanks. Production process for the transformers

main components includes; core slitting, core cutting, core stacking, low voltage winding, high voltage winding, active part assembly and connections. At the same time the transformers tanks production process shall be running. Such process includes; folding, welding, final assembly and leakage testing. Finally, both the transformers components and the tanks go through a painting and drying process before they go through their final testing process. Then the order is shipped to customers after being completely tested for any defects. All the power transformers from 50 KVA to 5000 KVA go through the same production process. That is why - from the factory's head view point – the factory executives did not need to identify various value streams. They only identified one value stream for all the transformers. At the same time the different power and size of the transformers produced entail that they actually take different processing time in each production process.

Figure 2: Value Stream Map for Company X Transformers Factory



During the analysis of the Transformers factory value stream, production processes were identified as machine intensive/machine-based processes, labor-based processes and production processes that can be categorized as quality control ones. In Figure (2), the shaded eight production processes are those in which the different power transformers take different processing time. This is in addition to the fact that the sales and engineering departments as well as any general and administrative departments involved in the execution of an order are located outside the factory in the company administrative plant and operate to support the production of all transformers. Accordingly, this data analysis of the factory's manufacturing data collected resulted in concluding that such identification of the value stream creates a condition of shared resources. In such condition, all types of transformers are supervised with the same production supervisors, inspected with the same quality controllers and are being processed through the same machines. However, they are in fact using different processing time in most of the value stream processes. This means that the different types of transformers produced use resources differently and as a result they cannot be assigned the same production cost per unit.

4.2 Costing Data Analysis

This phase is concerned with analyzing how the company costs its transformer products in such condition of shared resources. Table (1) shows the total costs for Company X Transformers factory as of December 31st, 2016.

The factory produces all types of transformers throughout the year, but due to confidentiality of most of the Egyptian Companies costing data, the data supplied by the Company's accounting and finance department included the calculations of the per unit costs for both the 500 KVA and the 1000 KVA transformers only during year 2016. The chief accountant controller reports that since the application of lean manufacturing there were many years in which the demand and consequently the factory production was in the ratio of forty percent of the 500 KVA transformers and sixty percent of the 1000 KVA transformers. During 2009, one thousand eight hundred transformers were

produced. Consequently due to the restrictions on the data supplied for two transformers only, the same demand and production percentages are assumed for year 2016.

In Table (1) the shaded items represent the overhead costs for the factory. The "basis" column shows the criteria by which each cost is allocated to a transformer unit. From the "basis" column in Table (1) it can be concluded that almost all the overhead costs are allocated more or less on basis of the production units. This is because, the main manufacturing process cost (MPC in Table 1) is computed on basis of the output units produced and the remaining overhead costs are allocated to individual transformer units as a percentage of this manufacturing process cost. Consequently, the analysis of Company X Transformer's factory costing data leads to concluding that the Company uses the traditional costing method of overhead allocation.

This case study focuses on the unit cost of the 500 KVA transformer as the data collected in terms of costs and mainly cost drivers – for implementing the ABC framework – are for the 500 KVA transformer. Under the traditional overhead allocation method currently used by company X the cost of one 500 KVA transformer during 2016 totals L.E.87,100 per unit. Company X Transformers factory requires a profit margin of 15%. Accordingly, during 2016 the selling price for the 500 KVA transformer totals L.E. 102,470.59 per unit.

In order to develop an answer to the first research question, the cost of one 500 KVA transformer is first computed using the VSC method. During 2016, Company X Transformers factory received a total of 600 orders which constitutes 2,400 transformers. As mentioned earlier 1,800 transformers were produced of which 1,400 units were shipped to customers. Given that the factory defines only one value stream for all produced transformers, the application of VSC to compute product unit cost results in an average cost per unit of L.E. 139,217.35 (L.E. 194,904,287/1400 units). This average unit cost shall apply for all products regardless of the fact that each transformer type (SDT, MDT or LDT) use the Company's and the factory's resources differently.

Table 1: Total Costs for Company X Transformers Plant for Year 2016

	Cost Item	Basis	Total Cost in EGP
1	**Material**		
1.1	Direct Material costs		154,872,426
1.2	Material Overhead	% of DM cost	1,471,289
	Total Material Costs		***156,343,715***
2	**Direct Manufacturing Cost**		
2.1	Manufacturing Process Cost (MPC)[3]	No. of production units	4,875,099
	Total Direct Manufacturing Cost		***4,875,099***
3	**Manufacturing Overheads**		
3.1	Engineering and Design	% of MPC	902,870
3.2	Quality Cost	% of MPC	407,069
3.3	Maintenance	% of MPC	1,247,060
3.4	Other Production OH[4]	% of MPC	4,704,956
	Total Manufacturing Overhead Costs		***7,261,955***
	Total Manufacturing Costs/TMC (1+2+3)		**168,480,769**
4	**Technology and Product Development**		
4.1	Product / System Development	% of TMC	5,896,827
	Total Tech. and Product Develop. Costs		***5,896,827***
5	**Other Special Direct Cost**		
5.1	Provision for warrantees	% of Total Material Costs	781,715
5.2	Financing Costs:		
	• Calculated Interest	% of TMC	1,684,807
	Total Special Direct Costs		***2,466,522***
6	**Contingencies and Provisions**		
6.1	Contingency for material Increase	% of TMC	3,369,615
6.2	Provision for Currency Risk	% of TMC	1,684,807
	Total Contingencies and Provisions		***5,054,422***
	Total Production Costs/TPC (TMC+ 4+5+6)		**181,898,540**
7	**Sales & Admin Costs**		
7.1	Sales & Marketing Costs	% of TPC	3,637,980
7.2	General & Administration Costs	% of TPC	9,367,767
	Total Sales & Admin Costs		***13,005,747***
	Full Costs (Production Costs + Sales & Admin Costs)		**194,904,287**

The cost computed using VSC far exceeds the one computed by Company X Transformers factory using the traditional overhead allocation method by L.E. 52,117.35.

[3] Includes salaries of workers in labor-based and machine-based production processes as well as depreciation of machines in machine-based production processes.

[4] Costs for production supervision, factory energy and water, factory depreciation as well as costs for machines and factory insurance.

That is almost 60% increase in the transformer's unit cost. Table (2) shows a comparison between the selling price of a 500 KVA transformer applying the VSC method and the selling price of the same transformer using the traditional overhead allocation method. Table (2) also integrates to this comparison the unit selling price set for the same product by the company's three competitors. Applying the same profit margin requested by the factory to the average product unit cost computed under VSC gives a selling price of L.E. 163,785.12. Comparing this selling price to the selling prices set by the factory's competitors for the 500 KVA, shows that it departs a lot from the selling prices set by the competitors of Company X Transformers factory, which indicates that the product unit cost may be distorted.

Table 2: Comparison of Selling Prices set by Company X Transformers Factory and Its Competitors for one 500 KVA Transformer during 2016.

Selling prices for One 500 KVA Transformer during 2016					
Company Name	**Company X Transformers Factory**		**Company A**	**Company B**	**Company C**
	Traditional Costing	**VSC**			
Selling price/unit in EGP	102,470.59	163,785.12	103,200	102,000	104,100

Also, it will be illogic and financially inaccurate to set the same product unit cost for all types of transformers produced even though they use the Company's resources differently. This is in addition to the admission of the Company's accounting and finance controllers and the factory head that the way their different transformer types use resources acts as a barrier to the application of any costing method that computes the same product unit cost for all types of transformers. Consequently, it can be concluded that for Company X Transformers factory, using VSC to compute an average product unit cost that applies for all products results in computing inaccurate product unit costs. The

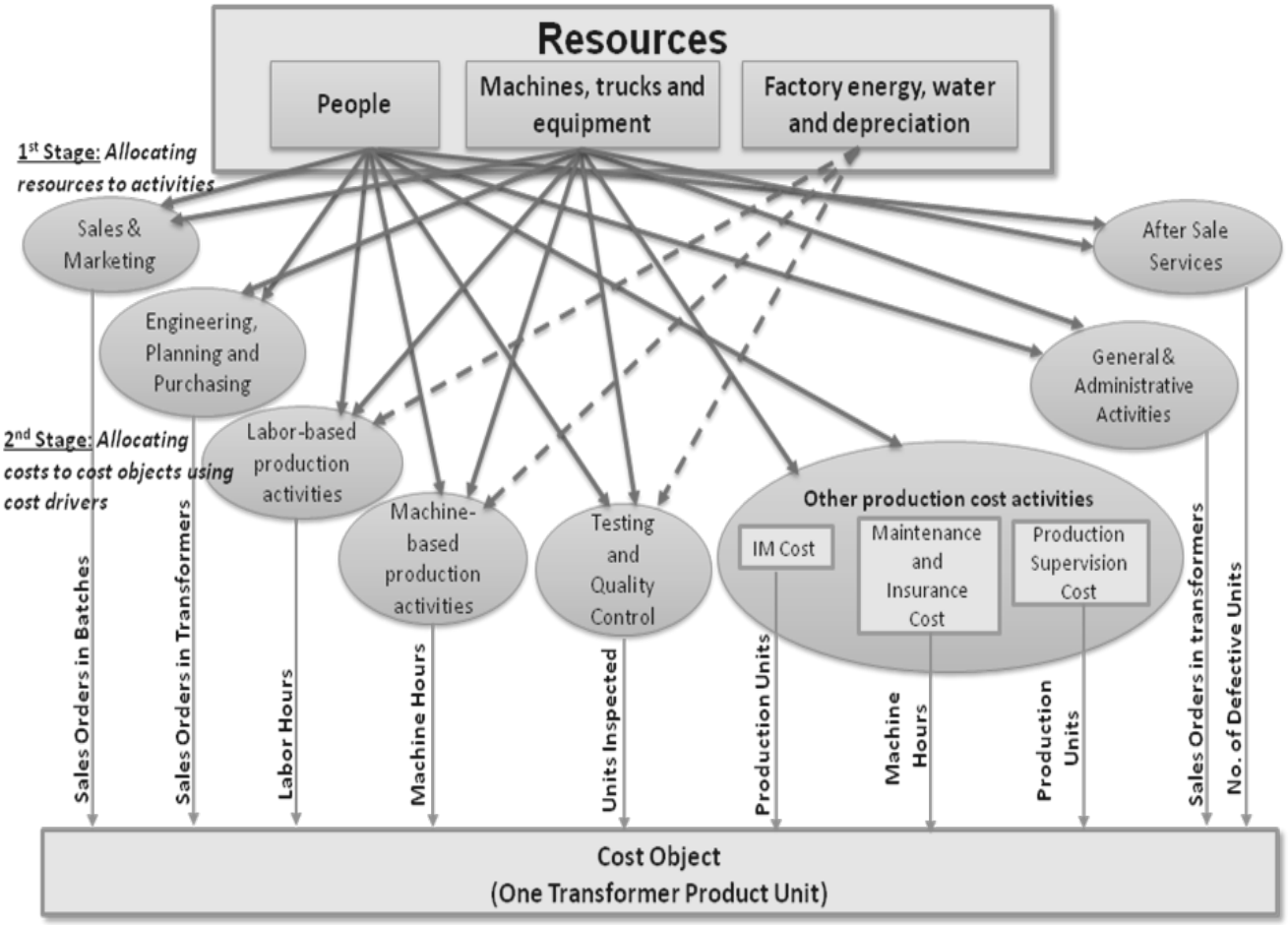
inaccuracy of product unit cost shall have its effect on the product's price and thereby may negatively affect the factory's competitive position.

At the same time, Company X Transformers factory still depends on product unit costs to price its local and exported products which include 30% of its total produced units. Also, even though the factory uses a pull production approach it still uses product unit costs for some ending inventory valuation purposes. This is because the factory receives large orders that require a long production execution period that may reach one year. As a result, computing an accurate product unit cost is of much importance to the factory's operations and to ensure accurate product pricing decisions.

Consequently, the two main conclusions reached through the analysis of the factory's manufacturing data collected and the analysis of its costing data collected provide some positive insights for implementing the study framework. That is, given these conditions for Company X Transformers factory, an application of an ABC system to compute product unit cost may help compute more accurate product unit costs and may resolve any costing distortions that result from identifying only one value stream for the three main types of transformers.

The implementation of the ABC suggested framework is shown in Figure (3). First, the cost for factory energy, water and depreciation are assigned to the main factory processes utilizing them. These processes include the six labor-based production activities, the seven machine-based production activities and the three quality control activities shown previously in Figure (2). Costs for factory energy, water and depreciation are allocated to labor-based, machine-based and quality control activities according to the average utilization ratio given by the factory's chief accountant controller (19% for labor-based activities, 73% for machine-based activities and 8% for quality control activities).

Figure 3: Suggested Framework for Implementing ABC in Company X Transformers Factory



According to the steps required to fulfill a customer order, from customer demand till product shipment, overhead costs for year 2016 highlighted in Table (1) are divided into eight cost activities, as shown in figure (3). These activities are:

1. *Sales and Marketing Activities:* the sales and marketing activities cost rate is computed on basis of the total batches of sales orders received (600 sales order) since sales orders are mostly received in batches.

2. *Engineering, Planning and Purchasing Activities:* The costs to operate the engineering, planning and purchasing department in addition to the department's share of the administrative plant rent and energy are assigned to individual transformer units on basis of the total sales orders received in transformers (2,400 units).

3. *Labor-based Production activities:* This includes the salaries for all direct labor workers working directly on the products plus the energy, water and factory depreciation costs assigned to the six labor-based activities shown in Figure (2). Since all the factory workers who are operating directly on the products and on the machines take the same average monthly salary, their costs can be considered as a direct labor cost for which a direct labor cost rate is computed. Then the factory energy, water and depreciation costs rate is computed on basis of the total labor hours that shall be worked in each activity. These costs are then assigned to individual transformer units on basis of the actual labor hours worked.

4. *Machine-based production activities:* These activities include the depreciation cost for all machines used in the machine-based production activities plus the factory energy, water and depreciation costs assigned to these machine activities. Overhead cost rate for these activities is computed on basis of the total machine hours that shall be worked by all the machines manufacturing transformers. These costs are then assigned to individual transformer units on basis of the actual machine hours worked.

5. *Testing and Quality Control Activities:* This includes costs paid in the three quality control processes shown in Figure (2), in addition to the factory energy, water and depreciation assigned to quality control activities. These costs are allocated to transformers on basis of the number of units inspected.

6. *Other Production Cost Activities:* This includes the cost centers for indirect material costs, maintenance and insurance costs as well as production supervision costs. Indirect material and production supervision costs are assigned to products on basis of the number of units produced. Maintenance and insurance costs are assigned to transformer product units on basis of the actual machine hours worked.

7. *General and Administrative Activities:* Costs for general and administrative activities are assigned to individual transformer units on basis of the total sales orders received in transformer units.

8. *After Sale Services:* This includes the provision for warranty costs. Such costs are assigned to transformer units on basis of the number of defective units.

The Application of the ABC suggested framework to allocate overhead costs to one unit of the 500 KVA transformer results in a unit cost of L.E. 86,211.4 for year 2016. Table (3) shows a comparison between this product unit cost, the one computed by the company and the one computed using the VSC method. As shown in Table (3), computing the unit cost for one 500 KVA transformer using the suggested ABC framework results in a lower unit cost, compared to the product's unit cost computed using the traditional costing overhead allocation method. This cost is lower by L.E. 888.6 per unit, such difference may seem trivial but in concept the application of ABC provides more insights on the drivers behind the company's costs. These findings answer the second research question which tackles the ability of ABC to provide accurate product unit costs in a lean environment. Actually, the application of the ABC approach to overhead allocation is found to provide a cause and effect relationship between the company's costs and their drivers. This is achieved through the use of accurate cost drivers that explain how the resources of the company are being used.

Table 3: Unit Cost for one 500 KVA Transformer using Different Approaches to Product Costing computed for Company X Transformers Factory in 2016.

	Traditional Costing	**VSC**	**ABC Suggested Framework**	**ABC – traditional**	**ABC – VSC**
Cost /unit	L.E. 87,100	L.E. 139,217.35	L.E. 86,211.4	L.E. (888.6)	L.E. (53,005.95) 38% decrease

Also, computing the product unit cost under the suggested ABC framework reinforces any costing distortions that the use of the VSC method may initiate under such condition of shared resources. This is shown in the huge difference between per unit costs computed for the 500 KVA transformer under the ABC and VSC, a difference of L.E. 53,005.95 per unit. This also coincides with the study and the factory executives' opinion that in concept when the main three types of transformers produced actually take different processing time and use the company resources differently, computing an average product unit cost that applies for all products produced does not provide accurate computation of product unit cost. That is why ABC computes more accurate product unit cost compared to the traditional costing system adopted by Company X and to the lean accounting VSC method.

In an attempt to develop an answer for the third research question on the ability of ABC to enhance a lean company's competitive position, the selling price of a 500 KVA transformer is computed using the product unit cost computed using the ABC framework. Table (4) presents a comparison between this selling price and the one computed by Company X Transformers factory as well as the one computed using the VSC method and the selling price set by the three competitors of the company for the same product. The inaccurate product unit cost computed using VSC is reflected in achieving the highest selling price for Company X Transformers factory that highly departs from its competitors.

Table 4: Comparison of Selling Prices set by Company X Transformers Factory and Its Competitors for one 500 KVA Transformer during 2016.

Selling prices for One 500 KVA Transformer during 2016						
Company Name	**Company X Transformers Factory**			**Company A**	**Company B**	**Company C**
	Traditional Costing	VSC	ABC suggested framework			
Selling price/unit in EGP	102,470.59	163,785.12	101,425.18	103,200	102,000	104,100

This large difference between the 500 KVA unit cost computed using VSC and using the ABC suggested framework affects the company's pricing decisions and thereby affects its the competitive position as well.

Table (5) also shows that given this condition of shared resources, the application of the ABC approach to overhead allocation can help support lean manufacturing principles. Actually, the use of most of the cost drivers mentioned previously is found to support lean behaviors and motivate waste elimination. The use of sales orders as a driver for sales and marketing costs, engineering costs as well as general and administrative costs supports the lean manufacturing pull principle. Allocating these overhead costs on basis of the sales orders promotes sales and not overproduction behaviors as lower overhead rates are achieved with more sales. Promoting sales in a lean environment requires a better understanding of the customer value adding activities and better meeting the customer demanded quality level and delivery times. Consequently, this also supports the lean manufacturing value principle.

Also, the use of units inspected as a cost driver for quality control activities motivate the lean manufacturing value principle. This is because achieving low quality cost rates may indicate that more products are being inspected which signifies the factory's due concern to maintain good quality products that meet the customer needs.

Table 5: Summary of Cost Activities and How their Cost Drivers can Support Various Lean Principles.

Cost Activity	Cost Driver	Supported Lean Principle/Behavior
▪ Sales and Marketing ▪ Engineering, planning & purchasing ▪ General & Administrative	Sales Orders	Value and Pull principles
Labor-based production activities	Labor Hours	▪ Waste elimination ▪ Continuous improvement
Machine-based production activities	Machine hours	▪ Waste elimination ▪ Continuous improvement
Maintenance and Insurance costs	Machine hours	Flow principle
Testing and Quality Control	Units Inspected	Value principle

The fact that costs for labor-based and machine-based activities are assigned to transformer units on basis of the actual labor hours and actual machine hours worked help separate the idle capacity costs from the actual cost used by the transformers produced. Such isolation highlights the costs of wasted resources that can be either eliminated through continuous improvement efforts or can be used to produce other demanded products. Also, using machine hours as the cost driver for maintenance and insurance costs helps support the lean manufacturing flow principle. A low maintenance cost rate may imply less machine hours worked which may indicate a condition of machines breakdown consequently corrective actions can be taken to improve the process flow.

This implies that, the way ABC cost drivers help support lean manufacturing principles can eventually help Company X Transformers factory to better meet customer demands and achieve a good competitive market stand.

Also, according to the applied case study most of the value stream activities for Company X Transformers factory are value adding activities as each step add a value to the customer starting

from the receipt of sales orders till the delivery of products. However, if the factory succeeded to apply an effective pull purchasing system in which suppliers are involved in supporting the flow of the production process. The Company can eliminate a lot of the materials inspection costs which add up to the costs of testing and quality control activities. It may also lead to decreasing the provision for warranty costs since in such pull purchasing system less defective units are expected to be produced.

Using the number of defective units as the cost driver for warranty costs help show the effect of applying a pull purchasing system and can indicate when the provision for warranty costs shall decrease. The number of defective units can also indicate when materials inspection can be considered as a non value adding activity. Such identification of value adding and non value adding activities also supports the lean manufacturing approach to waste elimination. This leads to optimizing the process flow, better meeting the customer demands and consequently achieving a better competitive position.

Finally, the way ABC links costs to their causes through the use of accurate cost drivers helps the calculated overhead rates to act as indicators for the factory's performance. This suggests that, the application of ABC can initiate some performance indicators that can be used together with the lean accounting suggested performance measures to better evaluate the factory's performance. This can also contribute to the factory's competitive position through the development of more performance measures that promote continuous improvement efforts.

5. Summary and Conclusion

This study intended to test the effect of integrating the ABC allocation method in a lean environment to help enhance lean firm's competitive position in a condition of shared resources. From the applied case study, it can be concluded that the application of VSC approach to cost products in lean firms is not incorrect. It is just that it may distort the product cost if it is applied in a condition where the company's resources are still interrelated. The integration of ABC in a condition of shared resources initiated due to an ineffective value stream definition of the studied Company's factory provides an accurate product unit cost. This cost is more accurate than the

one developed by the Company using the traditional overhead allocation method. It is also more accurate than the one computed using the VSC approach to product costing.

ABC develops a cause and effect relationship that links costs to their sources. Also the integration of ABC in the studied lean factory was found to support various lean behaviors and lean manufacturing principles. ABC helps the studied factory identify value adding and non value adding activities as well as develop cost drivers that can act as indicators that can support lean accounting performance measures used. Therefore, this suggests that managers of the studied factory can better rely on their product costing data to improve the Company's competitive position. This also suggests that managers can become more motivated to continue to apply lean principles and become more matured with lean transformation. This way both the operating system (Lean manufacturing) and the accounting system will be working hand in hand to motivate a better competitive stand for the company.

The implications of this study can also provide insights for future managers seeking lean implementation. As per the discussed literature, the application of a customer focused manufacturing system such as the lean manufacturing system is highly recommended in today's global competitive market. However, Companies seeking lean implementation shall think of lean as a management philosophy and not as a set of tools. Consequently, having a condition of shared resources shall not lead managers and accountants to back off from implementing a lean manufacturing system nor to compute distorted product unit costs. Instead managers shall develop ways to tailor the current management accounting tools to resolve their costing problems and meet their lean needs. Also, it is recommended for Companies applying lean manufacturing and are planning to use VSC to cost their product units, to consider the idea of minimizing shared resources. Alternatively, they can plan for developing an accurate cost allocation method like the ABC.

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