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## A COMPARATIVE ANALYSIS OF IMPLEMENTATION OF LEAN ACCOUNTING IN MANUFACTURING AND HEALTHCARE SECTORS

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### Abstract

Lean accounting is an emerging strategy that is being used by enterprises to achieve their business objectives. Several studies are reporting the implementation of lean accounting in manufacturing and healthcare sectors. However, no study has been conducted to compare lean accounting implementation in both sectors. This research reviews, analyzes and compares lean accounting implementation in manufacturing and healthcare sectors. A qualitative approach based on literature review and content analysis is used. Data is collected from secondary sources including journal articles and publications on practical case studies of lean implementation in both manufacturing and healthcare sectors. The analysis of the data reveals that three tools are commonly used for lean accounting implementation in both sectors, namely, Value Stream Mapping, Kaizen and Lean Six Sigma. It is also found that top manager commitment, flexible organizational culture, proper planning, and training are common requirements for the success of lean accounting implementation in manufacturing and healthcare. With regard to the challenges in implementing lean accounting in both sectors, the study discovers the existence of two common barriers including the shortage of people with knowledge of lean accounting principles and the lack of step-by-step guidelines on how to implement these principles. Finally, the study reveals that the outcomes of lean accounting implementation in both sectors are customers' satisfaction, cost reduction, and flexible communication amongst the staffs within the organization. The study is a contribution to knowledge in that it investigates and highlights the lean adoption practices specific to each of the manufacturing and healthcare sectors, as well as the commonalities of lean practices in both sectors.

**Keywords:** Lean Accounting, Manufacturing Sector, Healthcare Sector, Lean Tools

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### 1. Introduction

Enterprises are interested in improving performance and customer satisfaction to increase profitability, competitiveness and sustainability in the market (Manzouri *et al.* 2014). To this end,

lean is seen as a suitable approach (Woehrlé and Shady, 2010; Alobaidy, 2019). The term lean originated from the Toyota manufacturing company in the 1900s (Grove *et al.* 2010a). Lean is a strategy that was developed to improve the enterprise's traditional accounting costing methods while addressing the following weaknesses: misallocation of overheads, high cost, functional approach focus, restricted communication between manager and employees, and so forth (de Arbulo-Lopez and Fortuny-Santos, 2010; Enoch, 2013). It is further argued that the implementation of lean strategy is hampered by traditional accounting system due to the fact that traditional accounting system was designed to support traditional costing methods (Bahadir, 2011; Soliman, 2020). This created the need for a new system called lean accounting to support lean implementation in enterprises (Maskell and Baggaley, 2006).

Lean accounting in simple terms is a change that needs to be done within an enterprise to support the implementation of lean principles which can be summarized as: cost reduction, elimination of waste, increase customer value, continuous improvement, reduce step in transaction processing and development of a culture of change within the enterprise (Maskell and Baggaley, 2006; Ofileanu and Topor, 2014; Soliman, 2017; Alobaidy, 2019; Cecevic and Dordevic, 2020).

Lean accounting is being implemented in diverse industry sectors including manufacturing and healthcare. The literature presents many case studies of lean accounting implementation in manufacturing and healthcare enterprises (Rahman *et al.* 2013; Matt and Rauch, 2013; Skeldon *et al.* 2014). Naveen *et al.* (2013), Moori *et al.* (2013), Nordin *et al.* (2010) and Poksinska (2010) reported several challenges that make many lean implementation projects unsuccessful within the manufacturing and healthcare sectors. Furthermore, different practices, tools and methods are being used to carry out lean accounting implementation in both manufacturing and healthcare sectors. However, no study has been conducted to compare lean accounting implementation approaches in both sectors in terms of (1) the requirements for lean adoption, (2) the approaches or methods used, (3) the challenges encountered during lean implementation, (4) the criteria of success and failure, and (5) the outcomes of lean implementation. Such a comparative study would provide useful information to any organization interested in starting any lean initiatives.

This research reviews, analyzes and compares lean accounting implementation in manufacturing and healthcare sectors. These are the two sectors in which lean was first introduced (Houchens and Kim, 2014), therefore, various case studies of lean implementation in these sectors are available in the literature. In addition, the application of lean in other sectors is still in its infancy (Leite and Vieira, 2015). A qualitative approach based on literature review and content analysis is used. The analysis of the data collected reveals that several tools are used for lean accounting implementation in manufacturing and healthcare sectors. However, three tools are commonly used for lean accounting implementation in both sectors, namely, Value Stream Mapping, Kaizen and Lean Six Sigma. It is also found that top manager commitment, flexible organizational culture, proper planning and training are common requirements for the success of lean accounting implementation in manufacturing and healthcare. With regard to the challenges in implementing lean accounting in both sectors, the study discovers the existence of two common barriers including the shortage of people with knowledge of lean accounting principles and the lack of step by step guidelines on how to implement these principles. Finally, the study reveals that the outcomes of lean accounting implementation in both sectors are customers' satisfaction, cost reduction and flexible communication amongst the staffs within the organization.

The rest of the paper is organized as follows. Section 2 presents the literature review of the study. The methodology of the study is presented in Section 3. Section 4 focuses on data analysis and results. The overall findings and discussions are provided in Section 5. The last section concludes the paper and provides some recommendations.

## **2. Literature review**

### **2.1. Lean accounting implementation in manufacturing**

Lean accounting can be described as a new strategy that focuses on the implementation of lean thinking (Maskell and Baggaley, 2006). Lean thinking is the development of a culture of

continuous change within the enterprise in order to increase productivity, flexibility and customer's value (Ofileanu and Topor, 2014). The term lean accounting was launched in 2005 at the lean accounting summit (Ofileanu and Topor, 2014).

The lean accounting practice in the manufacturing sector is referred to as lean manufacturing (Maskell and Kennedy, 2007). Lean manufacturing was first introduced by Womack *et al.* (1990) and was adopted by many industrial companies in the 1990s (Kumar *et al.* 2013). It is a manufacturing system that aims at satisfying customers' need, with the emphasis on waste elimination in the production process (Zoran *et al.* 2022; Singh and Belokar, 2012; Chiarini, 2013). Waste is any activity that does not add value to the end product and include the following: overproduction, waiting time, production defects, holding high level of inventory, delay in transportation, processing and motion (Singh and Belokar, 2012). According to Robinson *et al.* (2012), waste in the manufacturing process can be eliminated by applying the following lean principles: (1) identify what constitute value for the customer, (2) identify all the steps necessary to design and manufacture the product, (3) continuous making the value added activity flow, (4) only manufacture what is pulled or required by the customer and (5) always seek perfection through continuous improvement. A number of tools are being used in the manufacturing companies to implement the lean principles including: Value Stream Mapping, Kaizen, Lean Sigma, Kanban, Just in Time, Total Productive Maintenance, 5S (Sort, Set in order, Shine, Standardize and Sustain) and Total Quality Management (Woehrle *et al.* 2010; Nordin *et al.* 2010; Soliman, 2017; Davim, 2018; McKie *et al.* 2021). Many authors including Maskell and Kennedy (2007), Satao *et al.* (2012) and Kumar *et al.* (2013) present the benefits derived from the application of lean manufacturing including waste elimination, cost reduction, higher productivity, and customer satisfaction. The next paragraphs review case studies of lean accounting implementation in manufacturing sector.

Several studies describe the application of lean accounting in the manufacturing sector. In Chakraborty and Sanjoy (2010), a framework for implementing lean manufacturing in a garment company in Bangladesh is presented. The authors started with the analysis of the existing manufacturing process to find its limitations. They used the Value Stream Mapping to identify value added and non-value added activities in order to propose a layout and process flow aligned with lean principles including increase productivity, effective inventory management, timely availability of accessories, and garment quality. To measure the changes, they made a comparison between the existing and the proposed process using the arena simulation software to visualize the result of the new system.

Singh and Belokar (2012) used the Kaizen tool to implement lean manufacturing in a company in India called assembly shop of tractor. They started with the observation and analysis of the existing manufacturing process in this company with the aim of identifying the weaknesses of the existing manufacturing system and the solutions to overcome them, using lean tools. The study found that the major problem in the existing system was the increased cycle time of the machine used in the production process. Therefore, the authors used Kaizen to formulate a new process flow diagram that will reduce the cycle time of each machine, thereby, reducing waste, provide efficient utilization of machines, and increase capacity of the gear box assembly and production without defect.

Rahman *et al.* (2013) studied some Malaysian manufacturing companies that have successfully implemented the Kanban system. The authors visited those selected companies and interviewed the managers with the aim of understanding how their manufacturing process using Kanban works. The study found that these companies used the same production practices under Kanban. The study further suggests the following as the prerequisites for successfully implementing Kanban: effective inventory management, reliability of supplier with regard to timely delivery, manager and employee's dedication and quality improvement and control. Finally, the authors designed an internal Kanban Flow derived from several observations at Malaysian manufacturing companies.

Matt and Rauch (2013) focus on the implementation of lean manufacturing in small sized enterprises in Italy. The authors interviewed ten small manufacturing firms in Italy to find out why they do not apply lean principles. The summarized responses included lack of knowledge of lean tools, manager lack of education on the benefit of lean, continuous used of traditional system and

lack of resources. As a solution, the authors suggested new lean tools suitable for small enterprises including Value Stream Mapping, Kaizen, Zero Default, First in First out (FIFO), Just in Time, 5S and Kanban. These tools were further applied in a practical case study to experience lean production in a small sized enterprise in the North of Italy.

Kumar *et al.* (2013) developed a structural model using the Interpretive Structural Modeling (ISM) approach to implement lean manufacturing in Indian automobile industry. Based on the literature review, the authors identified eighteen variables used for lean implementation and conducted interviews with the experts and grouped these variables into dependent and independent categories. The dependent variables were those related to cost saving, whereas, the independent variables were related to top managers' dedication. The authors further used the ISM model to identify the correlation between the different variables and developed a structured approach for lean manufacturing implementation using these variables. The study concluded that the structured approach will facilitate the understanding of the interdependency between the variables and will in turn facilitate lean manufacturing implementation in India automobile industry. The next subsection presents lean accounting implementation in healthcare.

## 2.2. Lean accounting implementation in healthcare

Lean accounting was first initiated to support the implementation of lean manufacturing in industrial companies; but nowadays lean accounting is also applied in service sectors including the healthcare, telecommunication and insurance sectors (Enoch, 2013). In the healthcare sector, lean accounting is commonly referred to as lean healthcare. Lean healthcare can be defined as an effective way to provide care quality service to patients through the application of lean thinking (De Barros *et al.* 2021; De Souza, 2009).

Grove *et al.* (2010b) and Hirisatja *et al.* (2014) agree that lean thinking within the healthcare, is a philosophy that aims at achieving the following goals: (1) Provide high quality service to patient; this goal is aligned with the patient's satisfaction, by providing him with care quality service, (2) Elimination of waste; this goal is also perceived from patient's point of view and consists of elimination of non-value added activity to patient experience such as long waiting time before being serviced, long waiting time from laboratory results, and medical errors, (3) cost reduction; this is the result of the two previous goals and (4) seeking perfection through continuous removal of non-value added activity. The goals presented above are also the lean principles in healthcare and can be applied through the use of the several lean tools including: Value Stream Mapping, Kaizen, Just in Time, Lean Six Sigma, 5S. Case studies of lean accounting implementation in healthcare are reviewed in the next paragraphs.

Lean healthcare has been a subject of interest to many researchers in the past years (Dickson *et al.* 2009; Grove *et al.* 2010a; Skeldon *et al.* 2014). In the study by Dickson *et al.* (2009), the implementation of lean principles of waste elimination in emergency department of four hospitals in the United States is studied. The authors visited each of the four hospitals and interviewed managers who were involved in the implementation process of the lean principles. They found that those hospitals were using the Kaizen system for the implementation and that an improved version of Kaizen suitable for healthcare was further developed. Finally, the authors compared the results of lean implementation in each of the four hospitals and concluded that each of the four hospitals implemented lean independently on their own way but using the same method, and the overall benefit was a performance improvement.

Another experience of lean implementation in a large primary Care Trust service in the UK is presented in Grove *et al.* (2010a). The authors participated in a thirteen months' lean implementation project that used the following lean tools: Value Stream Mapping, stakeholder mapping and time-motion study. During the project, staffs were trained through a series of workshops; the Value Stream Mapping method was used to identify useful and non-useful activities in order to continuously improve efficiency, whereas, the time-motion was employed to quantify non useful activities with the view of evaluating the improvement made.

In Skeldon *et al.* (2014), the implementation of lean principles in Canadian clinics was performed. The study conducted an analysis of existing system and used the Value Stream Mapping method to identify the imperfections in the existing system. Thereafter, the Value Stream

Mapping and RIEs (Rapid Improvement Events) methods were used to implement a new system aligned to lean principles. The outcomes of the implementation included: increase patient satisfaction, reduction of patient cycle time, and increase effectiveness.

In comparison to the rest of the world, Kruger (2014) in South Africa illustrated how the Lean Six Sigma method can be implemented in the Gauteng healthcare organization in South Africa, in order to evaluate and improve their services. This was done after several workshops with Lean Six Sigma experts and some of the CEOs of healthcare facilities in the Gauteng province with the emphasis on how to implement lean sigma in healthcare and its benefits.

The studies discussed above focused on case studies of lean accounting implementation in manufacturing and healthcare sectors around the world. However, none of them have addressed the comparison of lean accounting implementation in both sectors with an attempt to report on the similarities and differences of tools used, the requirements for lean accounting implementation, the challenges encountered during implementation and the criteria that determine the successful implementation of lean accounting projects as it is done in this study. This study will provide useful information to enterprises that want to start any lean initiatives. The study's research design and methodology are presented in the next section.

### **3. Research design and methodology**

#### **3.1. Research design**

A qualitative research approach based on content analysis is used in this study. According to Creswell (2009), qualitative research is an approach which seeks to collect, analyze and interpret qualitative data. 'Qualitative data' refers to the existing and available data from sources such as books, journal articles, conference proceedings, theses and dissertations, and research reports.

Content analysis is a type of qualitative research method that aims at extracting relevant information from the content of documents such as books, newspaper, reports (Berg and Lune, 2014), and published articles on case studies (Seuring and Gold, 2012). In Bowen (2009), it is reported that the reason for using documents in research is to extract information that would help the researcher to generate the data needed to achieve the research objective. This will lead to the understanding of the issue under investigation. The content analysis is appropriate for this study as the data were collected from relevant documents. Specifically, the data used to conduct this study was collected from relevant journal articles and publications on case studies of lean implementation in manufacturing and healthcare sectors.

As advised by Pare and Kitsiou (2016), Flick (2011) and Williams (2007), the following prescribed steps in content analysis research were applied in this study: (1) identify relevant documents, (2) review the documents and extract relevant information in the form of tables, (3) use figures or diagrams to quantify data to facilitate the analysis and (4) analyze the collected data and report on the findings.

#### **3.2. Research methodology**

The main objective of this research is to review, analyze and compare the implementation of lean accounting in manufacturing and healthcare sectors. In order to achieve this, a literature review is carried out to identify and use relevant documents that reported on case studies of lean accounting implementation in manufacturing and healthcare sectors. The documents used were found in scholarly journal articles and publications that reported on lean implementation in manufacturing and healthcare sectors. These documents were collected from different sources including the database of journals such as the Science Direct, Ebsco Host, scientific databases, and Google Scholar.

The search keywords include lean accounting, lean manufacturing, lean healthcare, lean implementation in manufacturing, lean implementation in healthcare. The search results produced a total of 45 publications. These publications were further narrowed down to 23 by assessing the relevance of their contents for the study; this was achieved by reading the title, introduction and conclusion of each publication. Out of the 23 publications, 12 focused on manufacturing and 11

on healthcare. The selected publications were those that reported on practical case studies on lean implementation in manufacturing and healthcare sectors.

Thereafter, the content analysis of the selected publications was performed to identify relevant data. The content analysis was done on all the selected publications; some of the articles were read several times to fully comprehend the content and collect relevant data. A preliminary analysis of the collected data enabled the definition of the parameters for the analysis and comparison. The defined parameters include the following: tools, requirements, barriers and criteria of success of lean accounting implementation in both sectors. Finally, the defined parameters are used to analyze, compare, and contrast lean accounting implementation in both sectors. The data collection and analysis are discussed in the next section.

#### 4. Data collection and analysis

As explained in the previous section, the relevant data were regrouped according to four defined parameters, including tools, requirements, barriers and criteria of success of lean implementation in both manufacturing and healthcare sectors. The collected data based on these 4 parameters, which form the basis for the analysis, were tabulated in sections 4.1 to 4.4.

The data analysis allows the researcher to extract information from the data and derive conclusion (Grove *et al.* 2010b). The objective of the analysis in this study is to compare lean accounting implementation in the manufacturing and healthcare sectors. As highlighted in the previous subsection, the data collected from the identified publications that reported on case studies on lean implementation were tabled; this provided the foundation for the analysis. The analysis and the parameters employed were inspired by the study by Poksinska (2010). Four main parameters are used for the comparison including: (1) Lean accounting tools adopted in manufacturing and healthcare, (2) requirements for lean accounting implementation, (3) barriers encountered during lean accounting implementation, and (4) criteria determining the success of lean accounting projects. The next subsection deals with lean accounting tools in manufacturing and healthcare sectors.

##### 4.1. Lean accounting tools in manufacturing

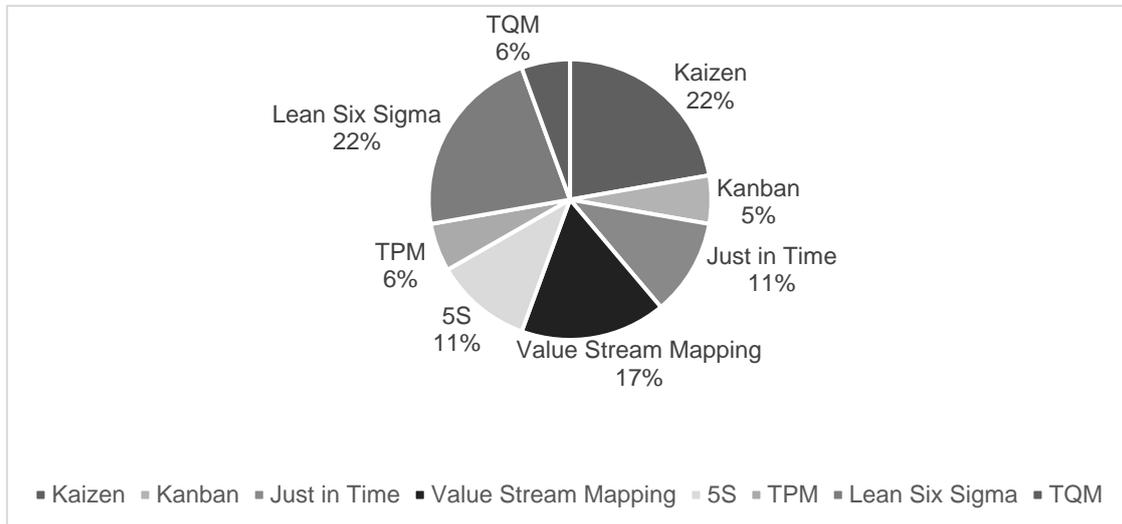
This subsection presents lean accounting tools used in the manufacturing sector as in Table 1. These tools include Value Stream Mapping, Kaizen, Kanban, Juste in Time, Lean Six Sigma, Total Quality Management (TQM), Total Productive Management (TPM) and 5S.

**Table 1. Lean accounting tools used in manufacturing**

Tools	Descriptions	References
Value Stream Mapping	Enables the visual representation of all activities needed to manufacture a product	Woehrle <i>et al.</i> (2010), Chakraborty and Sanjoy (2010), Soliman, (2017)
Kaizen	Reduces costs and identifies areas that need continuous improvement in the manufacturing processes	Muslimen <i>et al.</i> (2011), Singh and Belokar (2012), Matt and Rauch (2013), Nordin <i>et al.</i> (2010)
Kanban	Minimizes costs in the production process through the elimination of overproduction	Rahman <i>et al.</i> (2013)
Just in time	Eliminates waste associate with excess inventory and overproduction	Muslimen <i>et al.</i> (2011)
Lean Six Sigma	A continuous improvement tool which enables to achieve zero defect production	Zhang <i>et al.</i> (2012), Psychogios <i>et al.</i> (2012), Alhuraish <i>et al.</i> (2017)
Total quality management	A continuous improvement tool that aims at providing quality products to customer	Krishnan and Parveen (2013)
Total productive maintenance	An equipment maintenance tool which aims at avoiding breakdown of equipment during the production process	Ghosh (2013), Saihong <i>et al.</i> (2016)
5S	Uses to reduce waste by properly organize the work place	Matt and Rauch (2013), Nordin <i>et al.</i> (2010)

Source: Author's computation

Table 1 presents lean accounting tools used in manufacturing sector. Furthermore, the number of publications that have reported the use of each tool in Table 1 was counted. This enables to draw Figure 1 that illustrates the intensity of use of lean accounting tools in the manufacturing sector. Figure 1 is similar to that in Nordin *et al.* (2010 and Zhang *et al.* (2012).



**Figure 1. Chart of the intensity of use of lean accounting tools in manufacturing sector**

Figure 1 shows that the commonly used lean accounting tools in manufacturing are Lean Six Sigma and Kaizen (22%). A similar result was obtained in (Nordin *et al.* 2010). Another lean accounting tool that has been considerably adopted in the manufacturing sector is Value Stream Mapping (17%), followed by Just in Time and 5S (11%). The least used lean accounting tools in the manufacturing are Kanban (5%), TQM and TPM (6%). The lean accounting tools in healthcare are discussed in the next subsection.

#### 4.2. Lean accounting tools in healthcare

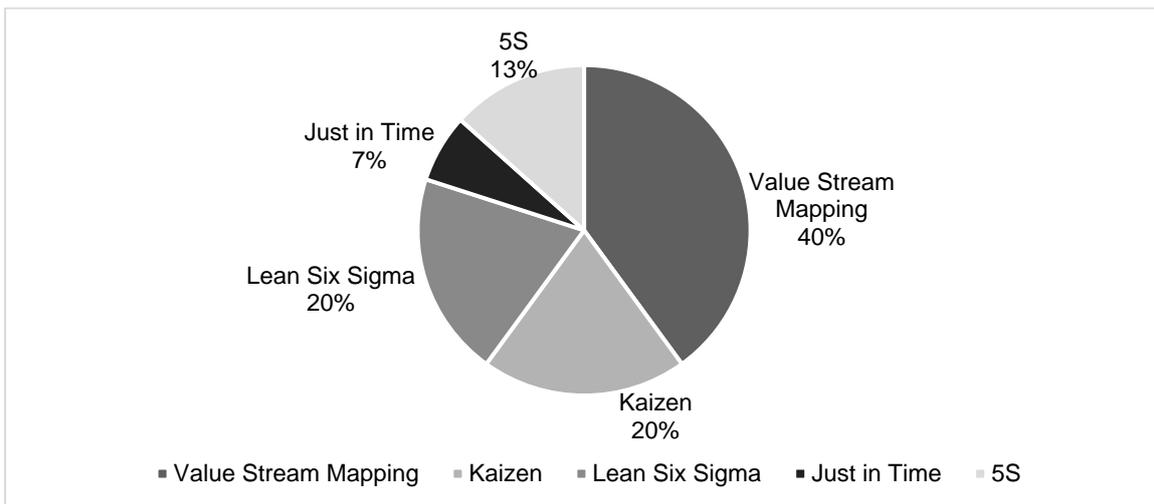
Table 2 shows the lean accounting tools applied in healthcare. Furthermore, the number of publications that have reported the use of each tool in Table 2 was counted and used to draw up in Figure 2. From Figure 2, it is shown that the Value Stream Mapping is the commonly used lean tool in healthcare (40%). A similar result was reported in Poksinska (2010). This can be attributed to the fact that Value Stream Mapping is the lean accounting tool used to identify value added and non-value added activities from patient's experience (Dickson *et al.* 2008; Grove *et al.* 2010a). The second most popular lean accounting tools in healthcare are Kaizen and Lean Six Sigma (20%), followed by 5S (13%) and Just in Time (7%). Kaizen was also found to be the lean accounting tool widely adopted in manufacturing firms.

Figures 1 and 2 portrait that the Just in Time and 5S tools are less used in the healthcare than in the manufacturing sectors. A similar finding on the Just in Time tool was reported by Yasin *et al.* (2002) in healthcare. In fact, Just in Time is applied in manufacturing firms to eliminate waste from holding inventory, overproduction, production process and transportation (Woehrlé and Shady, 2010); however, these types of waste are not present in healthcare. This may justify the low percentage of adoption of Just in Time in healthcare. It can also be noted from Figures 1 and 2 that lean tools like TPM, TQM and Kanban seems to be exclusively used in the manufacturing firms. However, these tools can also be used in healthcare. TPM are used in manufacturing to improve the reliability and efficiency of equipment and machines (Ghosh, 2013) it could therefore, be a valuable tool in healthcare since the healthcare facilities also have a lot of equipment and machineries such as X-ray and radiology machines.

**Table 2. Lean accounting tools used in healthcare**

Tools	Descriptions	References
Value Stream Mapping	Enables the identification of necessary steps to properly deliver services to the patient	Grove <i>et al.</i> (2010a), Skeldon <i>et al.</i> (2014), Dickson <i>et al.</i> (2008), Fine and Golden (2009), Holden (2011), Chadha (2012)
Kaizen	A continuous improvement tool that aims at eliminating non value added activities to the patient	Dickson <i>et al.</i> (2009), Fine and Golden (2009)
Just in time	Uses to reduce patients waiting time before they receive service	Chadha (2012)
Lean Six Sigma	Uses to seek perfection by continuously improving the quality of services rendered to the patient	Kruger (2014), Yeh <i>et al.</i> (2011), Sabry (2014)
5S (Sort, Set in order, Shine, Standardize and Sustain)	Enables the reduction of waste in the work environment by better organizing the work place	Holden (2011), Chadha (2012)

Source: Author's computation



**Figure 2. Chart of the intensity of use of lean accounting tools in healthcare**

It is interesting to observe that some lean accounting tools like Value Stream Mapping, Kaizen and Lean Six Sigma are used in both industries; these tools aim at identifying what is of value to customer and continuously seek improvement in the delivery processes in both sectors (Enoch, 2013). In summary, these tools enable to achieve customer satisfaction and perfection through continuous improvement of processes in both manufacturing and healthcare sectors. The next subsection deals with the requirements for lean accounting implementation in manufacturing and healthcare sectors.

#### 4.3. Requirements for lean accounting implementation in manufacturing

According to Psychogios *et al.* (2012), the requirements for success or critical success factors can be seen as specific areas in the organization that need special attention in order to facilitate the implementation of a new strategy. The requirements to the successful implementation of lean accounting in manufacturing sector are presented in Table 3 and can be summarized as follows:

#### 4.3.1. Competence and commitment of top managers

Managers are responsible for the implementation of a new strategy; they should provide direction to the entire organization. To carry out these responsibilities, managers should have the knowledge and skills required; therefore, they need to be trained and committed in order to have a better understanding of lean accounting strategy and facilitate its implementation.

#### 4.3.2. Employees' participation

Employees are the key element of lean enterprise (Nordin *et al.* 2010); they should be seen as an important asset to the organization and be motivated and empowered to get involved in the change process and contribute to the successful implementation of lean strategy (Naveen *et al.* 2013; Rahma *et al.* 2013; Rose *et al.* 2014).

**Table 3. Requirements for the success of lean implementation in manufacturing firms**

Requirements	Sources
Effective inventory	Rahma <i>et al.</i> (2013)
Timely delivery management	Rahma <i>et al.</i> (2013), Rose <i>et al.</i> (2014)
Management dedication	Nordin <i>et al.</i> (2010), Naveen <i>et al.</i> (2013), Moori <i>et al.</i> (2013), Rahma <i>et al.</i> (2014)
Employee's involvement	Naveen <i>et al.</i> (2013), Rahma <i>et al.</i> (2013), Rose <i>et al.</i> (2014)
Achieve competitive advantage	Moori <i>et al.</i> (2013)
Proper planning	Rose <i>et al.</i> (2014)
Training of staff	
Motivation and empowerment of employees	
Abandon of traditional accounting method	Woehrle and Shady (2010)
Competence of manager	Nordin <i>et al.</i> (2010), Naveen <i>et al.</i> (2013), Moori <i>et al.</i> (2013), Rose <i>et al.</i> (2014)
Flexible organization culture	
Striving for business performance	Moori <i>et al.</i> (2013), Rose <i>et al.</i> (2014)
Management support	Muslimen <i>et al.</i> (2011)
Establishment of long term relation with customer	Naveen <i>et al.</i> (2013)

Source: Author's computation

#### 4.3.3. Flexible organizational culture

There should be a clear and open communication between manager and employees; employees should be involved in the decision process so that their behavior can support the adoption of the new strategy (Moori *et al.* 2013; Rose *et al.* 2014). Further, it is argued that team work and collaborative decision making is a crucial element for culture change and facilitation of the implementation of new strategy (Kumar *et al.* 2013).

#### 4.3.4. Establishment of a long term relationship with customer

A good relation with customer is an important success factor in lean manufacturing (Naveen *et al.* 2013). This can be achieved by providing value added activities to customers; these are the products that the customers are willing to pay for. By satisfying customers' needs the company is setting up durable relationship with them and hence achieve the lean principle of increase customer value.

#### 4.3.5. Timely delivery from suppliers

In manufacturing firms, suppliers are responsible for the supply of raw material needed to start the production process; those materials need to be delivered on time in order for the company to meet customer demands (Rahma *et al.* 2013; Rose *et al.* 2014). Lean principles prescribe the company to place an order from suppliers when the customer have requested the product; this is because the company wants to eliminate waste from holding a high quantity of inventory and overproduction which are considered to be non-value added activities. The next subsection discusses the requirements for lean implementation in healthcare.

#### 4.4. Requirements for lean accounting implementation in healthcare

Table 4 shows the requirements or factors that guide the lean accounting success in healthcare. These requirements or factors include: commitment of top manager, long term sustainability, development of lean culture, training, proper planning, customer satisfaction, and communication and team work.

**Table 4. Requirements for the success of lean implementation in healthcare**

Requirements	Sources
Commitment of top manager	Grove <i>et al.</i> (2010a), Zhang <i>et al.</i> (2012), Punnakitikashem <i>et al.</i> (2013), Sabry (2014), Skeldon <i>et al.</i> (2014)
Long term sustainability	Skeldon <i>et al.</i> (2014)
Development of lean culture	Zhang <i>et al.</i> (2012), Punnakitikashem <i>et al.</i> (2013), Sabry (2014), Skeldon <i>et al.</i> (2014)
See lean as a continuous activity	Fine and Golden (2009)
Training	Fine and Golden (2009), Holden (2011), Grove <i>et al.</i> (2010a), Sabry (2014)
Proper planning	Grove <i>et al.</i> (2010a)
Desire to focus on customer satisfaction	Dickson <i>et al.</i> (2009), Holden (2011)
Communication and team work	Fine and Golden (2009), Holden (2011), Zhang <i>et al.</i> (2012), Punnakitikashem <i>et al.</i> (2013), Sabry (2014)

Source: Author's computation

#### 4.4.1. Commitment of managers and involvement of employee

Managers at all levels should be engaged on lean accounting implementation project; they should motivate and support staff to participate in the change process (Punnakitikashem *et al.* 2013; Sabry, 2014; Skeldon *et al.* 2014).

#### 4.4.2. Training

For an organization to implement a new strategy successfully, the people in the organization should have knowledge about the new strategy; thus, it is a necessity to provide training and assign responsibilities to employees, so that they can be able to act on their own and undertake the change required to successfully apply lean accounting principles (Fine and Golden, 2009; Holden, 2011; Grove *et al.* 2010a).

#### 4.4.3. The organizational culture

The organization should adopt a lean culture, which is a culture of flexible communication, team work (Holden, 2011; Zhang *et al.* 2012; Punnakitikashem *et al.* 2013; Sabry, 2014; Skeldon *et al.*

2014), and continuous improvement of value from the customer’s perspective (Dickson *et al.* 2009).

Tables 3 and 4 portrait some similarities of requirements or success factors of lean accounting principles in manufacturing and healthcare sectors. In fact, top manager commitment was identified in both sectors as key requirement or factor for lean accounting implementation. Another requirement or factor recognized as influencing lean accounting implementation in manufacturing and healthcare is organizational culture. In fact, developing a lean culture within the organization adjusts the way people believe (Punnakitikashem *et al.* 2013). Proper planning and training were also considered to be critical requirement or factor for lean adoption in both sectors, whereas, timely delivery from supplier and efficient inventory management were found to be critical success factor only in manufacturing sector. The barriers to lean accounting implementation in manufacturing and healthcare are discussed in the next subsection.

**4.5. Barriers to lean accounting implementation in manufacturing and healthcare**

The barriers or challenges encountered during lean accounting implementation in manufacturing sector are provided in Table 5; they include (1) lack of human and capital resources, (2) lack of qualified managers to direct lean accounting projects, (3) lack of proper planning and supervision and (4) not enough literature or books that provide guidelines for lean accounting implementation.

**Table 5. Challenges encountered during lean accounting implementation in manufacturing**

Barriers	Sources
Lack of human and capital resources	Nordin <i>et al.</i> (2010), Matt and Rauch (2013)
Lack of understanding of lean principles	Nordin <i>et al.</i> (2010)
Lack of qualified managers to direct lean projects	Muslimen <i>et al.</i> (2011)
Lack of proper planning and supervision	Muslimen <i>et al.</i> (2011)
Not enough literature or books that provide guidelines for lean accounting implementation	Muslimen <i>et al.</i> (2011)

Source: Author’s computation

Similarly, there are challenges in implementing lean accounting in healthcare as presented in Table 6 including difficulty in defining waste in healthcare, no focus of customer value, feeling by staffs that lean implementation would take away their jobs, physician not committed to lean strategy, and lack of flexible communication between physician and low level staff, qualified personnel, knowledge of lean accounting principles and belief in the success of lean accounting implementation.

**Table 6. Challenges encountered during lean accounting implementation in healthcare**

Barriers	Sources
Difficulty in defining waste in healthcare	Grove <i>et al.</i> (2010b)
Lack of flexible communication between physician and low level staff	Dickson <i>et al.</i> (2008), Grove <i>et al.</i> (2010b), Poksinska (2010)
No focus on customer’s value	Dickson <i>et al.</i> (2008), Grove <i>et al.</i> (2010b), Poksinska (2010)
Lack of qualified personnel	Dickson <i>et al.</i> (2008)
Lack of knowledge of lean principles	Grove <i>et al.</i> (2010b)
Lack of belief in the success of lean implementation	Poksinska (2010), Fine and Golden (2009)
Feeling by staff that lean implementation would cut their jobs	Fine and Golden (2009)
Physician not committed to lean strategy	

Source: Author’s computation

Lean accounting is a new strategy that required organization to change the way the company is doing things; the change process cannot occur without any challenges. There are many barriers to lean accounting implementation in both manufacturing and healthcare sectors as is evident in Tables 5 and 6. The lack of knowledge of lean accounting principles as well as step by step guidelines are common barriers to lean accounting implementation in both manufacturing and healthcare sectors (Nordin *et al.* 2010; Grove *et al.* 2010b). Another barrier is the lack of human and capital resources (Nordin *et al.* 2010; Matt and Rauch, 2013). Human resources is a definitive challenge to lean accounting implementation because there are few people with good knowledge of lean accounting principles; many people in the organization do not understand lean accounting practice, managers themselves do not know much about lean accounting and do not have the leadership required to direct its implementation (Muslimen *et al.* 2011). Furthermore, Punnakitikashem *et al.* (2013) argued that poor management and leadership style lead to unsuccessful lean implementation in some organizations. In the healthcare sector, apart from the lack of knowledge of lean principles, another problem is the belief by the healthcare staffs that lean implementation would take away their jobs; furthermore, the healthcare staffs are not convinced that lean can also be applied in healthcare successfully; for them, lean is a strategy that can only be applied in the manufacturing industry (Poksinska, 2010).

Punnakitikashem *et al.* (2013) stated that lean implementation requires significant investment; this supports the lack of capital resources as a challenge to lean adoption. Other challenges that hamper lean implementation in healthcare are the non-focus on customer as well as the difficulty to define waste. In fact, in healthcare, one does not really know who the customer is. Poksinska (2010) argued that there is confusion in the identification of customer in healthcare, since the customer can be the patient, the relatives of the person who settle the bill, the local community, the charities and insurance companies. This ambiguity in customer definition is a big challenge for lean implementation in healthcare, since one of the principles of lean is to increase customer satisfaction by identifying what is value and non-value to the customer. Therefore, if the right customer is not clearly defined, it would be difficult to applied lean and see the benefits derived from it. The direct consequence to the lack of a clear definition of customer is the difficulty to determine what waste is, in the process of service delivery (Grove *et al.* 2010b). An additional challenge to lean adoption in healthcare is the lack of communication between medical doctors and low level employees. In fact, medical doctors are trained to work independently (Poksinska, 2010) but lean practice required people in the organization to work as a team; furthermore, there should be a flexible communication between top and low level staff in order to provide clearly formulated objectives for all.

From the analysis above, it appears that there are many barriers to lean accounting implementation in healthcare compare to the manufacturing sector. This can be attributed to the fact that healthcare facilities have recently adopted lean practices, whereas, manufacturing companies have been applying lean principles for years. In fact, manufacturing companies have started applying lean since 1945 (Grove *et al.* 2010b), whereas, the adoption of lean in healthcare started in 2001 according to Robinson *et al.* (2012). The criteria that justify the success of lean accounting implementation in manufacturing and healthcare sectors are discussed in the next subsection.

#### **4.6. Criteria of success of lean accounting implementation in manufacturing and healthcare**

The success of lean accounting implementation in manufacturing and healthcare is measure in terms of outcomes or benefits obtained as represented in Table 7 and 8.

**Table 7. Outcomes for successful implementation of lean accounting in manufacturing sectors**

Outcomes	Sources
Elimination of waste and cost reduction	Muslimen <i>et al.</i> (2011), Singh and Belokar (2012), Rahman <i>et al.</i> (2013), Ghosh (2013)
Improvement of productivity	Matt and Rauch, (2013), Ghosh (2013), Singh and Belokar (2012)
Efficient utilization of resources	Chakraborty and Sanjoy (2010)
Production with zero defect	Singh and Belokar (2012)
Facilitate communication within the organization and development of good relationship among worker	Chakraborty and Sanjoy (2010)

Source: Author's computation

#### 4.6.1. Waste and cost reduction

It is the result obtained from successfully applying lean accounting strategy. It is achieved through waste elimination in the manufacturing processes. Waste in manufacturing sector is any activity that does not add value to the final product including holding of unnecessary material or work in progress that is not used in the production of final goods, production of goods in excess to the customer demand (overproduction), production defect, unnecessarily moving of material and underutilization of people in the production (Muslimen *et al.* 2011; Singh and Belokar, 2012; Rahman *et al.* 2013; Ghosh, 2013).

#### 4.6.2. Improvement of productivity

This is achieved by improving the manufacturing processes as well as the production of quality products with zero defects (Singh and Belokar, 2012) that satisfy customer's needs, since lean focus on waste reduction and efficiency in all aspects of production, tools such as Just in Time and Kaizen are used in the manufacturing process to minimize costs and increase outputs; thereby, providing the quality and quantity products to customers.

#### 4.6.3. Efficiency utilization of resources

It is the result of using a lower input to produce greater output (Chakraborty and Sanjoy, 2010). In Table 8, the outcomes of lean accounting implementation in healthcare are presented. They focus on waste elimination, cost reduction, patient satisfaction, and good behavior and communication amongst healthcare staff.

**Table 8. Outcome for successful implementation of lean accounting in healthcare sector**

Outcomes	Sources
Elimination of waste and cost reduction	Grove <i>et al.</i> (2010a), Fine and Golden (2009)
Improve care quality service delivered to patient	Dickson <i>et al.</i> (2008), Skeldon <i>et al.</i> (2014), Yeh <i>et al.</i> (2011)
Increase patient satisfaction	Dickson <i>et al.</i> (2008), Skeldon <i>et al.</i> (2014)
Behavioral change	Dickson <i>et al.</i> (2009), Holden (2011)
Development of flexible communication and team work	Holden (2011)

Source: Author's computation

#### 4.6.4. Increase patient satisfaction

This is achieved by improving the quality of service delivered to patient (Yeh *et al.* 2011; Dickson *et al.* 2008; Skeldon *et al.* 2014) as well as eliminating waste (Grove *et al.* 2010a; Fine and

Golden, 2009). Waste in healthcare is any activity that does not add value to the patient and include: long waiting time before receiving the care needed, long waiting time for laboratory results and medical errors (Grove *et al.* 2010a).

#### **4.6.5. Behavioral change**

After witnessing the success of lean accounting implementation, healthcare staffs change their behavior toward continuous improvement in the way they serviced the patient (Dickson *et al.* 2009; Holden, 2011). Through lean implementation journey they understand that their primarily responsibility is to increase patient satisfaction (Skeldon *et al.* 2014).

#### **4.6.6. Communication and team work**

Lean accounting implementation improve communication across different department of the organization and enhance collaboration and team work. The analysis of Table 7 and 8 shows that the outcomes of lean accounting implementation in both manufacturing and healthcare sectors are closely the same and are centered on three main benefits including: customers' satisfaction, cost reduction and flexible communication within the organization. However, the behavioral change benefit was only obtained in healthcare; this can be attributed to the fact that healthcare staffs initially believe that lean accounting is only applicable in manufacturing (Poksinska, 2010); however, this behavior change with their participation in a lean accounting project.

### **5. Findings and discussions**

#### **5.1. Findings on lean accounting implementation in manufacturing**

Lean accounting implementation requires the use of a certain number of tools, principles and methods (Maskell and Baggaley, 2006). It was discovered that different tools are being used in lean accounting projects in the manufacturing sector including: Kaizen, Value Stream Mapping, Lean Six Sigma, Just in Time, 5S, Kanban, Total Productive Maintenance (TPM) and Total Quality Management (TQM) (Satao *et al.* 2012; Matt and Rauch, 2013; Rahman *et al.* 2013). It was also found that Kaizen and Lean Six Sigma are the popular tools used in lean accounting projects within the manufacturing industry. A similar finding was reported in Nordin *et al.* (2010). The study also revealed that other lean accounting tools that are commonly used in the manufacturing sector are Value Stream Mapping, Just in Time and 5S. The tools including Kanban, 5S, Value Stream Mapping and Just in Time enable the manufacturing companies to reduce their costs of production (Enoch, 2013; Ofileanu and Topor, 2014; Rahman *et al.* 2013). In effect, the Value Stream Mapping tool enables to identify the essential steps in the design and manufacturing of products, whereas, Just in Time enforces the manufacturing of products at the customer request. On the other hand, the continuous improvement of the manufacturing processes is guided by the Lean Six Sigma, Kaizen, TQM and TPM tools. In summary, lean accounting tools are used in the manufacturing industry to increase customer value and improve the productivity, thereby, enhancing the overall lean accounting strategy in the manufacturing enterprises.

With regard to lean accounting projects outcomes in the manufacturing industry, the study found that some prerequisites need to be in place for lean projects to be successful. These prerequisites are called critical success factors (Rose *et al.* 2014) and can be grouped into five categories including: (1) top manager commitment, (2) employee participation, (3) flexible organizational culture, (4) establishment of long term relationship with customer and (5) supplier participation. Beside these success factors that are viewed as facilitating the success of lean accounting projects in the manufacturing sector, the study also discovered that there are barriers to lean accounting projects implementation.

These barriers or challenges encountered during lean accounting projects implementation encompass: misunderstanding of lean methodology, organizational structure, and lack of resources, direction, communication and manager support. The analysis of data further revealed that the results derived from the successful implementation of lean accounting projects are measured in terms of financial benefit (increase revenue and decrease in cost),

operational performance (quality product, efficient utilization of resources and increase productivity), customer and employee satisfaction (good and enjoyable working environment) and the development of culture of change within the manufacturing industry.

## **5.2. Findings on lean accounting implementation in healthcare**

Lean healthcare is about providing care and safe quality service at a lower cost through the elimination of waste like delay and length of stay in hospital to the patient. The study discovered that lean accounting tools used to eliminate waste from patient experience are: Value Stream Mapping, 5S and Kanban, whereas Kaizen and Lean Six Sigma are the tools used to continuously improve care quality service to patient (Dickson *et al.* 2008; Grove *et al.* 2010a).

The study further revealed key success factors of lean accounting projects in healthcare including: (1) commitment of top manager, (2) involvement of employee, (3) training and (4) organizational culture. Barriers to lean accounting implementation in healthcare were identified as well; they encompass: (1) attitude of staff in healthcare - manager and other employees often feel that lean accounting principles are inappropriate for hospitals; they believe that lean accounting strategy is only suitable for automobile and manufacturing companies (Poksinska, 2010), (2) difficulty of defining waste in healthcare, (3) lack of knowledge on lean accounting principles, (4) lack of flexible communication between medical doctors and lower level staff and (5) hierarchical organizational structure.

In summary, the outcomes of lean accounting implementation in healthcare include: improvement of quality service to patient, increase patient satisfaction, reduction of waiting time and length of stay in hospital (shorten patient experience), cost saving, change of way of thinking, increase level of manager commitment, and flexible communication within the organization.

## **5.3. Findings on lean accounting implementation in manufacturing and healthcare**

The aim of this research was to review, analyze and compare lean accounting implementation in manufacturing and healthcare sectors. This was achieved based on several criteria including the lean accounting tools used for the implementation, the requirements for lean accounting adoption, factors leading to the success of lean accounting projects as well as the barriers encountered during the implementation. These criteria are used as the main headings to present the overall findings of the study below.

### **5.3.1. Lean accounting tools**

From the analysis of lean accounting implementation in manufacturing and healthcare, it appears that several tools are used during implementation in both sectors. The study found that lean accounting tools including Value Stream Mapping, Kaizen and Lean Six Sigma are commonly used in both manufacturing and healthcare sectors. These tools enable the identification of what is of value to customer and continuously seek improvement in the delivery processes in both sectors (Enoch, 2013); in other words, they enable to achieve customer satisfaction and perfection through continuous improvement of processes in both manufacturing and healthcare sectors.

The study also revealed that Just in Time and 5S are the least used tools in the healthcare than in the manufacturing sectors. A similar finding on the Just in Time tool in healthcare was reported in (Yasin *et al.* 2002). In fact, Just in Time is applied in manufacturing companies to eliminate waste from holding inventory, overproduction, production process and transportation (Woehrle and Shady, 2010); however, these types of waste are not present in healthcare. This may justify the reduced use of Just in time in healthcare.

It also appeared that other lean tools like TPM, TQM and Kanban are exclusively used in the manufacturing firms. However, they could also be used in healthcare. For instance, TPM is used in manufacturing to improve the reliability and efficiency of equipment and machines (Ghosh, 2013); it could therefore be a valuable tool in healthcare too, since the healthcare facilities also have a lot of equipment and machineries such as X-ray and radiology machines.

### 5.3.2. Requirements for the success of lean accounting implementation

It was found that (Section 3, Tables 3 and 4) there are some similarities of requirements/success factors of lean accounting implementation in manufacturing and healthcare sectors. One of such similarities is the top manager commitment; this was identified in both sectors as key requirement/factor for lean accounting implementation. Another requirement/factor recognized as influencing lean accounting implementation in manufacturing and healthcare is organizational culture. In fact, developing a lean accounting culture within the organization influences the belief of people (Punnakitikashem *et al.* 2013). Proper planning and training were also considered to be critical requirement/factor for lean adoption in both sectors, whereas, timely delivery from supplier and efficient inventory management were found to be critical success factor only in manufacturing sector.

### 5.3.3. Barriers to lean accounting implementation

The study discovered many barriers to lean accounting implementation in both manufacturing and healthcare sectors (Section 3, Tables 5 and 6). The shortage of people with knowledge of lean accounting principles and lack of step by step guidelines on how to implement these principles are common barriers to lean accounting adoption in both manufacturing and healthcare sectors (Nordin *et al.* 2010; Grove *et al.* 2010b).

Another barrier is the lack of human and capital resources (Nordin *et al.* 2010; Matt and Rauch, 2013). In fact, the human resources is a critical challenge to lean accounting implementation in manufacturing and healthcare because, as mentioned earlier, there are few people with good knowledge of lean accounting principles; many people in the organization do not understand lean practice, managers themselves do not know much about lean and do not have the leadership required to direct its implementation (Muslimen *et al.* 2011). Furthermore, Punnakitikashem *et al.* (2013) argued that poor management and leadership style lead to unsuccessful lean implementation in some organizations. In the healthcare sector, apart from the lack of knowledge of lean principles, another problem is the belief by the healthcare staffs that lean accounting implementation would take away their jobs; furthermore, the healthcare staffs are not convinced that lean can also be applied in healthcare successfully; for them, lean is a strategy that can only be applied in the manufacturing industry (Poksinska, 2010). Punnakitikashem *et al.* (2013) stated that lean accounting implementation requires significant investment; this supports the lack of capital resources as a challenge to lean adoption.

The study also found that there are many barriers to lean accounting implementation in healthcare compare to the manufacturing sector. This can be attributed to the fact that healthcare facilities have recently adopted lean practices, whereas, manufacturing companies have been applying lean principles for years. In fact, manufacturing companies have started applying lean since 1945 (Grove *et al.* 2010b), whereas, the adoption of lean in healthcare started in 2001 according to Robinson *et al.* (2012). The conclusion, limitations and recommendations are provided in the next section.

## 6. Conclusion and recommendations

The main objective of this study was to review, analyze and compare lean accounting implementation in manufacturing and healthcare sectors. The study reviewed published research that report on lean accounting implementation in manufacturing and healthcare sectors to identify case studies. These case studies were further analyzed to discover the tools used in lean accounting implementation in both manufacturing and healthcare sectors. These tools were analyzed and compared; it appeared that in the manufacturing sector the implementation of lean accounting is carried out through the use of the following lean tools: Kaizen, Value Stream Mapping, Lean Six Sigma, Just in Time, Kanban, 5S, TPM and TQM, whereas, Value Stream Mapping, Kaizen, Just in Time, Lean Six Sigma and 5S are the tools used in lean accounting implementation in healthcare. Furthermore, the tools including: Value Stream Mapping, Kaizen,

and Lean Six Sigma are commonly used in both manufacturing and healthcare sectors, whereas, Just in Time is the least used tool in healthcare and tools like TPM, TQM and Kanban are exclusively used in manufacturing sector.

A thorough analysis of the case studies discovered from the literature, enabled to identify the requirements for lean accounting implementation in manufacturing and healthcare sectors; these requirements were further analyzed, compared and discussed. It appeared that the key requirements for lean accounting implementation in manufacturing include competence and commitment of top manager, employee's participation, flexible organizational culture, establishment of long term relationship with customers, timely delivery from supplier and effective inventory management, whereas, the requirements in the healthcare sector encompass: commitment of manager, employee's involvement, training and organizational culture. The requirements including top manager commitment, employees' participation and organizational culture appeared as leading factors to the success of lean accounting implementation in both sectors, whereas, proper inventory management and timely delivery from supplier were found to be critical success factors for lean accounting implementation in the manufacturing sector only.

The study further identified and analyzed the barriers or challenges to lean accounting implementation in manufacturing and healthcare sectors. In the manufacturing industry three barriers were identified including lack of human and capital resources, qualified managers to direct lean projects, proper planning and supervision and enough literature or books that provide guidelines for lean accounting implementation. Five barriers were identified in healthcare: lack of belief in the success of lean accounting implementation, lack of knowledge on lean principles, difficulty of defining waste in healthcare, hierarchical organizational culture and lack of flexible communication between physician and low level staff. It appeared that the shortage of people with knowledge of lean accounting principles and lack of step by step guidelines on how to implement these principles are common barriers to lean accounting adoption in both manufacturing and healthcare sectors.

Finally, the outcomes of lean accounting implementation in manufacturing and healthcare sectors were discussed. In the manufacturing sector, the main outcomes identified were: waste and cost reduction, improvement of productivity and efficient utilization of resources, whereas the outcomes in healthcare included increase patient satisfaction, behavioral change, and communication and team work. Comparatively, it appeared that the outcomes of lean accounting implementation in both manufacturing and healthcare sectors are closely the same and are centered on three main benefits including customers' satisfaction, cost reduction and flexible communication within the organization. However, the behavioral change benefit was only obtained in healthcare.

Despite the achievements presented above, this study has two major limitations. The first limitation is the reduced representation of the case studies used. In fact, the case studies from which the data for the research was collected, reported on lean accounting implementation in only few countries. This limitation could be addressed by conducting further research to investigate why the manufacturing and healthcare organizations of others countries are not adopting lean strategy. The second limitation of the study is the fact that it only focuses on lean accounting implementation in manufacturing and healthcare sector. Further research need to be done to investigate whether lean accounting can be implemented in other sectors such as sports and recreation or leisure, fast moving customer goods, financial sectors and so on.

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