BUJSS
9/1 (2016), 19-38

Mathematics and Excel Based Statistical Lean Accounting Implementation on a Construction Industry Firm

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ABSTRACT

Lean accounting and lean management are eye-catching concepts today in the highly competitive business world. Modern companies are trying hard to become leaner in order to be flexible, avoid waste, eliminate unnecessary costs and actions, decrease inventories, value customers and lower idle capacity. This research paper did run a statistical lean accounting implementation on a firm operating in the construction industry. Since the information and identity of mentioned construction industry firm is confidential, it was labeled and called as the CST Company. The study benefited from Excel software and mathematics for the statistical lean accounting implementation and 9173 records of 120 Accounts Receivable transactions belonging to CST Company were analyzed as the total universe. However, the research only considered 100 records of 120 Accounts Receivable transactions as the sample size. It was found that statistical lean accounting implementation using mathematics and Excel was very beneficial for CST Company, since the practice labeled 58 records out of 100 sample size as in attention (risky). It was determined that, these accounting receivable invoices (sums) should be monitored and investigated. Research findings are parallel to some former literature such as Womack and Jones (1994), Kocamış (2015), Cokins (2009) and Kabene (2011).

Keywords: Lean Accounting, Construction Industry, Statistics, Mathematics, Excel

Bir İnşaat Sektörü Firması Üzerinde Matematik ve Excel Tabanlı İstatistiki Yalın Muhasebe Uygulaması

ÖZ

Yalın muhasebe ve yalın yönetim günümüzün yüksek rekabetçi iş dünyasında öne çıkan ve dikkat çeken konulardır. Modern işletmeler esnek olmak, israfı azaltmak, gereksiz maliyet ve eylemleri elimine etmek, stok seviyelerini düşürmek, müşterilere değer vermek ve atıl kapasiteyi indirmek için gittikçe daha da yalın olmaya çalışmaktadır. Bu çalışma, inşaat sektöründe faaliyet gösteren bir firma üzerinde istatistiki yalın muhasebe uygulaması gerçekleştirmiştir. Araştırmaya konu olan firmanın bilgisinin ve kimliğinin gizli tutulması gerektiğinden ötürü, belirtilen inşaat sektörü firması CST Şirketi olarak ifade edilmiştir. Araştırma, istatistiki yalın muhasebe uygulamasını gerçekleştirmek için Excel yazılımı ve matematikten yararlanmış, CST Şirketi'nin 9173 adet 120 Alıcılar hesabı toplam evrensel kütle kapsamında analiz edilmiştir. Ancak, araştırma yalnızca 100 adet 120 Alıcılar hesabını toplam örneklem olarak dikkate almıştır. Araştırma sonuçları matematik ve Excel kullanılarak gerçekleştirilen istatistiki yalın muhasebe uygulamasının CST Şirketi için oldukça

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yararlı olduğunu göstermiştir, zira toplam örneklem olan 100 adet muhasebe kaydı içerisinde 58 adet kayıt dikkat (riskli) olarak etiketlenmiştir. Belirtilen alıcılar hesabı faturalarının (tutarlarının) incelenmesi gerektiği sonucuna varılmıştır. Araştırma bulguları geçmiş literature ait çalışmalardan Womack ve Jones (1994), Kocamış (2015), Cokins (2009) ve Kabene (2011)'nin bulgularıyla paralellik arz etmektedir.

Anahtar Kelimeler: Yalın Muhasebe, İnşaat Sektörü, İstatistik, Matematik, Excel

1.Introduction

Lean accounting process does not only refer to the implementation of lean principles, but it also points to the lean management approach. Therefore, this approach can be only achieved through lean production. From a historical perspective, lean production was initially developed by Toyota. As the owners of "Toyota Production System" which we frequently come across while discussing production, Toyota executives indicated that they built this system after they were inspired during their visit to "Ford Motor Company" in 1920 and it was developed after World War II by Taiichi Ohno as one of the leaders of Toyota and consultant Shigeo Shingo (Casas, 2011).

Towards the end of the 1980s, Lean Production Method was also adopted by leading American and European companies. Moreover, it was determined that lean thinking should be applied to all of the fields such as financial accounting and management accounting processes. There are two main factors for Lean Accounting. The first of these is the implementation of the lean method to the company's accounting, supervision and measurement processes. This is no different than applying the lean method to any process. Here, the objective is to increase capacity, expedite the process so that extravagant losses can be prevented, eliminate errors and mistakes and disambiguate the process and make it understandable (Womack and Jones, 1994).

A second and more significant factor of lean accounting is to change the auditing and measurement processes fundamentally. As a result, lean variation and development is instigated, information compatible with the control and decision-making processes are provided and it is ensured that the customer's worth is comprehended, while evaluating the financial effects of lean change accurately and potential losses are minimized by turning these into a simple and visual format. Contrary to traditional management accounting methods, lean accounting does not require procedures such as standard costing, activity-based costing (ABC), variance reporting, cost-plus pricing, controlling system for complex procedures and untimely confusing financial reports. Lean Accounting functions as lean performance measurement, simplified summary of marginal costing of value streams, decision-making and reporting with the employment of "Box Score[2]", financial eports submitted on time and with a "simple language" that everyone can understand,

[2] Box Score: Exhibits the operational, financial and capacity-related changes applied as a result of lean development.

orientation of the value created for the customers from a deep understanding towards lean changes, abolishing traditional budgeting through monthly sales, operation and financial planning processes, value-based pricing and accurate apprehension of the financial impacts of lean change (Maskell and Baggaley, 2006).

While an organization acquires more experience with lean ideas and methods, it was recognized that the combined methods employed by lean accounting have to be designed to secure the changes. Also, motivation is required for the success of the on-going lean transformation of the company. Moreover, planning of the lean management system integrated with operational and financial reporting is a must. Until 2006, a clear definition was not introduced for lean accounting methods, because they were developed by different individuals working at different companies. In 2005, Lean Accounting Summit conference was organized with the participation of several leaders and the decision adopted emphasized the need to further develop the document entitled "Lean Accounting Principles, Practices and Tools" (PPT). While lean accounting methods are constantly developed, PPT put forth the primary lean accounting methods and demonstrated how they can function jointly with the lean management system. PPT did not only highlight lean accounting methods and tools, but at the same time it underlined the requirement to concentrate on the need for valuing the customers and authorization of individuals (Asefeso, 2013).

There are certain elements which display the significance of lean accounting. These can be categorized as positive and negative. Positive ones can be listed as the following: (Kocamiş, 2015)

•Lean Accounting provides the information necessary for "Lean Decision-Making". An accurately adopted decision increases the revenue and profitability.

•With the elimination of unnecessary procedures, reductions are procured in terms of time and costs.

•It introduces key performance indicators focused on value investment and enhancement.

•Lean accounting motivates lean thinking in the long-term as it concentrates on lean based information and statistics.

•Lean accounting demonstrates the potential financial benefits of lean improvements and the strategies required to reach these benefits.

Even though lean accounting is frequently compared with and contradicts traditional accounting, we cannot state that traditional accounting is completely wrong and totally unnecessary. Traditional accounting systems are those that motivate mass production. If the company is taking firm steps and is determined to carry out mass production, then traditional accounting can contribute to their "future". However, given that lean production and lean thinking contradicts with the rationale of mass production, it will also contradict traditional accounting (Manos and Vincent, 2012).

The companies which utilize traditional accounting, traditional cost control and measurement systems are likely to encounter the following problems (Way, 2016):

•People are expected to be gravitated towards non-lean principles, production activities that involve high batches. High levels of inventories are also observed.

•Traditional systems are abundant in terms of extravagance. Employees work with busy schedules, they prepare reports which are not useful in any way and perform those tasks which do not provide any added value. In addition to these, employees do not even realize what they are doing and performing.

•Standard cost practices inflict damage on lean companies and those firms striving to become lean. Lean thinking contradicts the principles adopted by collective thinking. Mass production requires long-term production activities necessitated with scale of economics, while lean production focuses on the manufacture of a single product each time.

Traditional systems will result in those studies that encompass the preparation of reports indicating that the processes which have to be manufactured internally should be carried out through the use of outsourcing. That is why the executive decisions adopted will be undoubtedly erroneous. Do/Obtain analysis, profitability of the orders, product or customer rationalization can be presented as some of the examples at this point (IMA - Institute of Management Accountants, 1996).

Lean accounting vision is comprised of the following elements: Providing accurate, timely and understandable information, encouraging lean transformation organization-wide and increasing customer value, decision-making on growth, profitability and cash flow, preserving comprehensive financial control while using lean tools to prevent extravagance in accounting procedures, full compliance of Generally Accepted Accounting Principles (GAAPs) with external reporting arrangements and internal reporting conditions, supporting of lean culture by the investors, procurement of relevant and triggering information as well as reinforcing constant improvement at every level of the organization (Cokins, 2009).

Lean accounting can be utilized by executives, sales consultants, operation leaders, accountants and lean enhancement teams in order to provide accurate, timely and understandable information. This information provides a clear insight about the company's operational and financial performance. Lean accounting and reporting motivates the individuals involved in the organization for carrying lean improvement further. It is generally stipulated as "quantifiable things can be developed". Lean accounting measures the right items for a company that would aim to move forward with lean transformation (Stenzel, 2008).

Lean accounting facilitates the expedited procurement of information, reports and measurements. It does not require the employment of complex systems and extravagant transactions generally utilized by traditional production companies.

The simplicity of lean accounting enables finance and operation staff members to save time. Hence employees can act to achieve more active strategic objectives and they can play an effective role in carrying the company forward. While the role of the financial professional diverges from the role that entails accounting and reporting duties, it converges to a strategic partnership role jointly with the leaders of the company (Akdeniz, 2015).

If we were to investigate it at a deeper level, lean accounting matches with the cultural objectives of lean organization. Simplified and timely information bolsters the employees of an organization at all levels. Finance and performance measurement data are organized within the framework of value stream mapping and thus value stream management dignifies the "lean" principle. The emphasis on customer value is also derived from the principles of lean thinking. A company's accounts and measures are evaluated as a deep and essential task within the organizational culture. Lean accounting plays an important role within an organization by cultivating a lean culture (Chopra, 2013).

Lean accounting is clearly elucidated in the books authored by Bruce Baggaley and Brian Maskell. Lean Accounting refers to the management of companies in accordance with lean principles (Maskell and Baggaley, 2006). Lean thinking books elaborate on certain stages of "lean leaping". Part of the literature argues that "Lean Accounting" has to be applied after the third or fourth year. This is not a really well-founded statement. The reason is that, improvement or transformation actions are left half finished in several organizations as failures. One of most significant reasons underlying these failures is the incapability of demonstrating the improvement that has been made within financial statements. According to the general approach adopted by the finance managers, these amelioration actions are beneficial for the company. Therefore, returns are expected in a short period of time. However, these approaches are unfortunately not witnessed in real life. In other words, the pioneers of amelioration or lean transformation are hindered. In order to preclude these failures and to prevent the lean transformation from being interrupted, lean accounting has to be observed and evaluated step by step since the initial moment it is implemented (McWay, Kennedy and Fullerton, 2013).

Lean production and lean accounting resemble the chicken and egg analogy. However, even if lean production is actualized with immediate effect, traditional financial controls should not be abandoned at once. The controls being applied here should not be immediately lifted. Over time, lean management (or lean production) is envisaged to render numerous accounting processes as unnecessary. For example, detailed inventory records become particularly significant in an environment where long procurement periods are used and high inventory numbers are present. Therefore, separate financial systems are required for auditing purposes. However as procurement periods and inventory numbers are curtailed, Kanban or

similar retrieval systems are put into action, lean performance standards are being applied and the job becomes standardized, it is assumed that extra financial supervision instruments will not be required (Lin and Qingmin, 2009).

According to Baggaley and Maskell, production and accounting stages should be as the following while transferring from lean production to lean management: Pilot lean production cells - extended lean production - lean applications for customers and suppliers. The stages of lean accounting on the other hand include introduction to lean accounting - management with value streams - lean administration. Also, lean production is divided into three categories which can be listed as pilot lean production cells, company-wide lean production and proximity between partners and companies (Ferdousi and Ahmed, 2009).

Lean manufacturing characteristics of pilot lean production cells should be compatible with the following: (Miller, Pawloski, Standridge, 2010).

•Successful Lean Cellular Applications

•Training on Lean Principles

•Stream, Retrieval and Kanban

•Expedited Preparation and Single-Minute Exchange of Dies (SMED)

•Business Standardization

•Control and Auditing at Source

Stages that make up the lean costing of pilot lean production cells include the following: (Bell, 2005)

•Lean performance management of production cells

•Measurement of financial equivalence of lean improvements

•Elimination of a number of operational transactions

•Annulment of deviation reports and traditional measurements

•Preventing extravagance in financial accounting

•Mapping primary value streams of the company

•Determining fundamental factors of costs and performance

Manufacturing characteristics of company-wide lean production include the following:

(Dolcemascolo, 2006)

•Standardizations between the cells and one piece flow

•Boosting visual qualities

•Establishing and training continuous improvement teams

•Supplier certification and supplier Kanban

•Production with value stream

•Controlling processing, statistical processing control applications

•Monitoring Work in Process (WIP) goods and finished goods inventory

Stages of company-wide lean production include the following: (Aziz and Hafez, 2013)

•Determining the performance criteria for value stream at the company level

•Designating performance indicators compatible with the company strategy

•Switching to value stream costing instead of standard costing

•Ensuring the continuation of constant improvement in line with the results obtained from value stream costing

•Exercising value stream costing to measure costs and values

•Integrating finance to Standard Operating Procedures (SOP), sales and operational planning

Production qualifications related to inter-enterprise proximity: (Womack and Jones, 1994)

•Company organized with value stream

•Developed collaboration between the customers, suppliers and partners

•Acknowledging constant improvement as a style of life and vision

•Application of lean thinking to the entire organization

Lean costing of the inter-enterprise proximity is as the following:

(Knolmayer, Mertens, Zeier and Dickersbach, 2009).

•Utilization of target costing for customer values and ameliorations

•Employing target costing for the design of products, processes and business manners

•Extending value stream to the customers, suppliers and third party companies

•Removal of several purchasing and inventory control jobs

•Transferring routine accounting and recording tasks to automation or outsourcing

2. Literature Review

Existing literature provides a starting point for the identification of lean production. Moreover, it assists in highlighting the complexity within the conceptual and operational field surrounding lean production and in adopting a series of operational precautions (Karan, 2015).

Lean production is generally construed from two different perspectives. One of these is referred to as the philosophical perspective related to the guidance for principles and comprehensive objectives (Womack and Jones, 1996; Spear and Bowen, 1999), while the other entails a practical perspective focused on directly observable management practices, instruments or techniques (Shah and Ward, 2007; Li et al., 2005).

This difference in orientation does not signify a complete disagreement, but it may damage conceptual clarity. As a typical example, Just-in-Time is one of the four essential concepts of Total Production System

(TPS). In order to preserve just-in-time production at Toyota's facilities, Ohno (1988) designed the Kanban system to retrieve the materials from the higher station and to manage the flow of production (Gao and Low, 2014).

Furthermore, in order to contemplate on and measure just-in-time, Sugimori et al. (1977) concentrated on the most critical components such as Kanban, production smoothing and the reduction of time between production activities. These definitely focus on quality development and participation of employees (Hall, 1987; McLachlin, 1997). Furthermore, the mentioned components are customer-oriented (Flynn, Sakakibara, Schroeder, 1995).

Afterwards, JIT[3] has been transformed into the TPS system in the United States (US). Kanban with JIT have been acknowledged, since these terms were generally used alternately instead of each other (Hoop and Spearman, 2004). Similar concepts were also observed in other components of lean production such as quality management, people management and preventive maintenance approach (Anvari, İsmail and Hojjati, 2011).

The term “Lean” was initially used in an article authored by John Krafcik entitled "Triumph of the Lean Production System", which was based on his master’s thesis he wrote while pursuing his graduate degree at MIT Sloan School of Management. Before coming to MIT[4] for a master's degree on management, Krafcik was formerly working as a Quality Engineer at the "NUMMI" factory which is the joint investment of General Motors and Toyota. These studies conducted by Krafcik were then pursued with the International Motor Vehicles Program (IMVP) that performs research on the "global automobile industry and the future of automobile" established by MIT with a five million dollar budget. John Krafcik also worked at Ford for long years after IMVP[5]. Following this position, he became the Chief Executive Officer (CEO) of Hyundai Motor America in 2008 (Bergen, 2015).

The book authored by James P. Womack, Daniel T. Jones and Daniel Roos entitled “The Machine that Changed the World” published in 1991 as an output of this program explained the history of automobile production, compared automobile manufacturing methods in Japan, US and Europe and illustrated the basic components of Lean Production. “ The Machine That Changed the World”, was translated to 11 different languages besides Turkish and it sold more than 600.000 copies playing a significant role in the worldwide expansion of the term “Lean” (Womack, Jones and Roos, 1991).

Initially, Henry Ford had summarized his own production philosophy and the fundamental principles that the revolutionary Ford Production System (FPS) adopted in his book entitled "Today and Tomorrow" which was published in 1927. Toyota Motor Company was established in Koromo, Japan in 1937. Toyota cousins Kiichiro and Eiji formulated the Toyota Production System (TPS) which includes Taiichi Ohno's Ford

[3] JIT: Just-in-Time.
[4] MIT: Massachusetts Institute of Technology
[5] International Motor Vehicle Program

Production System (FPS). Just-in-Time (JIT) method was recognized as a key component of TPS (Toyota Motor Corporation, 2016).

In 1978, Ohno published "Toyota Production System" in Japanese. Here, he introduced the idea of JIT. According to Ohno, primary objective of TPS is to reduce costs (eliminate extravagance/waste) and this can be attained through quantity control, inventory guarantee and respect for humanity. He suggested that, the necessary product types should be manufactured only when it is necessary and at the required amount (Monden, 2014).

In 1973, oil crisis had a significant adverse impact on North America and pursuant to the publication of numerous academic and practical books, new Japanese production and management practices drew considerable attention. The first scholarly article was published in 1977 by Sugimori et al. The articles generally discussed the issues of production smoothing such as Kanban[6] and JIT as well as level loading (Monden, 1981).

Since the midst of the 1980s, Monden's "Toyota Production System" (1983) as well as Ohno's "Toyota Production System: Beyond Large-Scale Production" (1988) were published in English. In 1991, "The Machine That Changed The World" authored by Womack, Jones and Roos was published. The word machine here configures "Lean Production" to characterize Toyota's production system and the underlying components within the popular literature. This book analyzed the lean system in detail. However, it did not offer a specific and complete definition (Monden, 1983; Ohno, 1988; Womack, Jones and Roos, 1991).

By the midst of the 1990s, other articles related to the impact of various organizational variables with regard to JIT's measurement (Sakakibara, Flynn and Schroeder, 1993; Flynn, Sakakibara, Schroeder, 1995; McLachlin, 1997), total quality management (Ross, 1993; Dean and Bowen, 1994; Sitkin, Sutcliffe, Schroeder, 1994; Flynn et al., 1997) and their implementation were published in academic journals. "Lean Thinking" authored by Womack and Jones was published in 1994 (Womack and Jones, 1994).

Since 2000, numerous books and articles were published by academics, practitioners and consultants. Also, a few academic conceptual articles (Hoop and Spearman, 2004; De Treville and Antonakis, 2006) and experimental articles (Shah and Ward, 2007) were written to highlight the encompassing characteristic of lean production. Unfortunately, a completely clear and specific definition is still not present.

3.Data and Methodology

Acknowledged as the company which applies lean production in the most accomplished manner, Toyota has succeeded in becoming the best firm worldwide and it constantly tries to maintain this title. For most authorities, Toyota is recognized as the best company within the field of "production" globally (Hanna, 2014).

[6] Kanban: Kanban refers to the information system which is used to control production and material flow and instructs production process on how much and when certain items will be manufactured and where they will be sent.

It was observed that based on the sustainable productive performance results acquired by the companies which have actualized lean production, other companies implementing traditional management have also become inclined towards lean production over the last twenty years. Several articles and scholarly research have been published with regard to lean production and courses on lean production and lean management have been offered in many universities. As the use of lean management expands, companies employ lean management principles more and more even though some are not engaged in production. It is also observed that, lean principles are frequently used in industries such as informatics, construction and healthcare (Kabene, 2011).

First examples of lean management in Turkey were observed in the automotive industry during 1990s. With the impact of Toyota, automotive companies paid more attention to lean production and they encouraged their subsidiary industries to utilize this method. Lean applications have become more widespread in production, textile and similar industries over time. Thus, lean implementations nowadays attract the attention of the executives and many company owners in Turkey (Yükselen, Özkaya and Molla, 2014).

While Lean Thinking continues to develop, a standardized approach has not been introduced for accounting control and measurement. Therefore, understandable and integrated knowledge is not present. Lean accounting, lean production and lean management provide several advantages for enterprises. Increase of productivity and quality standards, timely delivery, added value and low levels of inventory also offer numerous benefits for enterprises in the context of lean thinking (White, 2010).

Manufacturers have been under an intense and continuous pressure to find new means for reducing production costs, eliminating extravagance (waste), increasing the product's superior quality and efficiency as well as improving customer satisfaction. These parameters are generally succeeded via the implementation of lean management practices within industries. It is observed that, traditional production practices remain inadequate for lean management (Chopra, 2013).

This research tries to touch upon the significance of lean production practices. Lean applications should develop more rapidly despite the recent improvements in this field. The primary reasons for the drawback of lean management in some firms include the concerns of the workers with regard to changes in attitude, lack of awareness and the insufficient training on concepts such as lean management, lean accounting and timing used in lean applications.For this reason, it is clearly observed that the industries have to place more emphasis on lean management in all of the fields. Therefore, all types of firms should be encouraged to organize lean awareness programs and adopt technological advancements along with lean training, education and research activities. These assist industrialists and researches in raising awareness on lean

management tools and techniques. Therefore, the preference of suitable lean applications and updated scenarios can take up a supportive role for the cease of ineffectiveness within competitive environments, applications and constant developments (Begam, Swamynathan, Sekkizhar, 2013).

The research is run a on a construction firm, which will be mentioned and called as the CST Company from now on. The main goals of lean accounting can be listed as eliminating waste, freeing up capacity, speeding up the processes, eliminating errors, fraud and defects as well as making the processes more clear. Methodology of this study specifically focuses on the error, fraud and defect eliminating component of lean accounting. For this purpose, the amounts (sums) of 120 Accounts Receivable records of CST firm are taken into consideration. The research has a complete set of data for 9173 records of 120 Accounts Receivable sums belonging to CST Company. However, only 100 records of 120 Accounting Receivable sums belonging to CST firm are taken as a sample from the total universe of 9173 records. This is because it is impossible to list all of the 9173 records in this research paper.

In addition to the amounts (sums) of 120 Accounts Receivable records, 2 Digits on Right of 120 Accounts Receivable sums, total frequency (9173 observations of 120 Accounts Receivable sums), observation numbers (observation no.), observed frequency in total universe, observed rate, expected rate, absolute difference, standard error, z (value) and check columns are included to the table (Table: 1) to run the implementation of lean accounting on CST Company using statistics.

Research also includes a figure (Figure 1), which illustrates a comparison of observed rates and expected rates. Observed rates are shown with a line in blue color and expected rates are shown with a line in red color. Also, the X Axis of Figure 1 shows the observation numbers and Y Axis of Figure 1 shows the observed rates / expected rates mathematically.

Table 1: Statistical Lean Accounting Implementation on CST Company

Amount	2 Digits on Right	Total frequency	Observation No	Observed frequency	Observed rate	Expected rate	Absolute difference	Standard error	Z (Value)	CHECK
60.515	76	**9173**	0	789	0,08601	0,01	0,076013	0,001039	73,169	ATTENTION
60.292	74		1	83	0,00905	0,01	0,000952	0,001039	0,916	
60.586	76		2	108	0,01177	0,01	0,001774	0,001039	1,707	
60.536	76		3	51	0,00556	0,01	0,004440	0,001039	4,274	ATTENTION
60.362	30		4	94	0,01025	0,01	0,000247	0,001039	0,238	
61.062	30		5	65	0,00709	0,01	0,002914	0,001039	2,805	
62.862	30		6	44	0,00480	0,01	0,005203	0,001039	5,009	ATTENTION
64.762	30		7	136	0,01483	0,01	0,004826	0,001039	4,646	ATTENTION
64.997	20		8	169	0,01842	0,01	0,008424	0,001039	8,108	ATTENTION
64.711	88		9	167	0,01821	0,01	0,008206	0,001039	7,899	ATTENTION
64.436	71		10	52	0,00567	0,01	0,004331	0,001039	4,169	ATTENTION
64.149	39		11	37	0,00403	0,01	0,005966	0,001039	5,743	ATTENTION
67.549	39		12	33	0,00360	0,01	0,006402	0,001039	6,163	ATTENTION
76.552	82		13	132	0,01439	0,01	0,004390	0,001039	4,226	ATTENTION
77.549	82		14	99	0,01079	0,01	0,000793	0,001039	0,763	
76.715	74		15	52	0,00567	0,01	0,004331	0,001039	4,169	ATTENTION
61.715	74		16	84	0,00916	0,01	0,000843	0,001039	0,811	
62.315	73		17	77	0,00839	0,01	0,001606	0,001039	1,546	
61.815	73		18	63	0,00687	0,01	0,003132	0,001039	3,015	ATTENTION
62.523	73		19	65	0,00709	0,01	0,002914	0,001039	2,805	
64.423	73		20	143	0,01559	0,01	0,005589	0,001039	5,380	ATTENTION
64.423	7		21	58	0,00632	0,01	0,003677	0,001039	3,540	ATTENTION
64.851	73		22	50	0,00545	0,01	0,004549	0,001039	4,379	ATTENTION
65.073	8		23	53	0,00578	0,01	0,004222	0,001039	4,064	ATTENTION
67.073	8		24	89	0,00970	0,01	0,000298	0,001039	0,286	
66.809	72		25	90	0,00981	0,01	0,000189	0,001039	0,182	
66.542	25		26	56	0,00610	0,01	0,003895	0,001039	3,749	ATTENTION
66.181	35		27	40	0,00436	0,01	0,005639	0,001039	5,428	ATTENTION
69.181	35		28	51	0,00556	0,01	0,004440	0,001039	4,274	ATTENTION
69.008	89		29	177	0,01930	0,01	0,009296	0,001039	8,948	ATTENTION
369.008	89		30	71	0,00774	0,01	0,002260	0,001039	2,175	
368.958	89		31	65	0,00709	0,01	0,002914	0,001039	2,805	
368.784	43		32	41	0,00447	0,01	0,005530	0,001039	5,323	ATTENTION
368.611	97		33	46	0,00501	0,01	0,004985	0,001039	4,799	ATTENTION
368.461	60		34	198	0,02159	0,01	0,011585	0,001039	11,152	ATTENTION
68.461	60		35	69	0,00752	0,01	0,002478	0,001039	2,385	
75.231	58		36	70	0,00763	0,01	0,002369	0,001039	2,280	
79.769	86		37	66	0,00720	0,01	0,002805	0,001039	2,700	
80.519	86		38	89	0,00970	0,01	0,000298	0,001039	0,286	
80.919	86		39	58	0,00632	0,01	0,003677	0,001039	3,540	ATTENTION
394.614	86		40	97	0,01057	0,01	0,000575	0,001039	0,553	
395.114	86		41	60	0,00654	0,01	0,003459	0,001039	3,330	ATTENTION
394.684	36		42	48	0,00523	0,01	0,004767	0,001039	4,589	ATTENTION
394.653	46		43	85	0,00927	0,01	0,000734	0,001039	0,706	
394.224	96		44	107	0,01166	0,01	0,001665	0,001039	1,602	
393.723	25		45	46	0,00501	0,01	0,004985	0,001039	4,799	ATTENTION
401.323	25		46	91	0,00992	0,01	0,000080	0,001039	0,077	
401.259	0		47	64	0,00698	0,01	0,003023	0,001039	2,910	
401.247	0		48	42	0,00458	0,01	0,005421	0,001039	5,218	ATTENTION
401.147	0		49	131	0,01428	0,01	0,004281	0,001039	4,121	ATTENTION
401.065	46		50	142	0,01548	0,01	0,005480	0,001039	5,275	ATTENTION
651.065	46		51	34	0,00371	0,01	0,006293	0,001039	6,058	ATTENTION
51.065	46		52	67	0,00730	0,01	0,002696	0,001039	2,595	
52.665	46		53	29	0,00316	0,01	0,006839	0,001039	6,583	ATTENTION
51.872	46		54	226	0,02464	0,01	0,014638	0,001039	14,090	ATTENTION
51.821	46		55	63	0,00687	0,01	0,003132	0,001039	3,015	ATTENTION
51.693	46		56	39	0,00425	0,01	0,005748	0,001039	5,533	ATTENTION
51.662	71		57	83	0,00905	0,01	0,000952	0,001039	0,916	
53.162	71		58	72	0,00785	0,01	0,002151	0,001039	2,070	
52.940	37		59	71	0,00774	0,01	0,002260	0,001039	2,175	
52.890	37		60	114	0,01243	0,01	0,002428	0,001039	2,337	
403.890	37		61	54	0,00589	0,01	0,004113	0,001039	3,959	ATTENTION
403.790	37		62	53	0,00578	0,01	0,004222	0,001039	4,064	ATTENTION
403.210	37		63	68	0,00741	0,01	0,002587	0,001039	2,490	
403.231	98		64	143	0,01559	0,01	0,005589	0,001039	5,380	ATTENTION
404.846	35		65	151	0,01646	0,01	0,006461	0,001039	6,220	ATTENTION
404.717	35		66	39	0,00425	0,01	0,005748	0,001039	5,533	ATTENTION
407.217	35		67	45	0,00491	0,01	0,005094	0,001039	4,904	ATTENTION
407.142	35		68	67	0,00730	0,01	0,002696	0,001039	2,595	
207.142	35		69	79	0,00861	0,01	0,001388	0,001039	1,336	
206.984	35		70	107	0,01166	0,01	0,001665	0,001039	1,602	
206.619	35		71	27	0,00294	0,01	0,007057	0,001039	6,793	ATTENTION
206.456	35		72	45	0,00491	0,01	0,005094	0,001039	4,904	ATTENTION
206.449	0		73	63	0,00687	0,01	0,003132	0,001039	3,015	ATTENTION
206.406	0		74	159	0,01733	0,01	0,007333	0,001039	7,059	ATTENTION
581.406	0		75	117	0,01275	0,01	0,002755	0,001039	2,652	
586.306	0		76	104	0,01134	0,01	0,001338	0,001039	1,288	
586.075	55		77	34	0,00371	0,01	0,006293	0,001039	6,058	ATTENTION
585.687	2		78	27	0,00294	0,01	0,007057	0,001039	6,793	ATTENTION
586.831	64		79	93	0,01014	0,01	0,000138	0,001039	0,133	
586.631	64		80	144	0,01570	0,01	0,005698	0,001039	5,485	ATTENTION
586.408	62		81	54	0,00589	0,01	0,004113	0,001039	3,959	ATTENTION
586.242	42		82	103	0,01123	0,01	0,001229	0,001039	1,183	
590.242	42		83	61	0,00665	0,01	0,003350	0,001039	3,225	ATTENTION
596.742	42		84	143	0,01559	0,01	0,005589	0,001039	5,380	ATTENTION
596.373	52		85	119	0,01297	0,01	0,002973	0,001039	2,862	
601.373	52		86	127	0,01384	0,01	0,003845	0,001039	3,701	ATTENTION
607.373	52		87	44	0,00480	0,01	0,005203	0,001039	5,009	ATTENTION
407.373	52		88	40	0,00436	0,01	0,005639	0,001039	5,428	ATTENTION
408.123	52		89	271	0,02954	0,01	0,019543	0,001039	18,812	ATTENTION
414.623	52		90	95	0,01036	0,01	0,000356	0,001039	0,343	
424.623	52		91	71	0,00774	0,01	0,002260	0,001039	2,175	
524.623	52		92	58	0,00632	0,01	0,003677	0,001039	3,540	ATTENTION
549.623	52		93	53	0,00578	0,01	0,004222	0,001039	4,064	ATTENTION
749.623	52		94	187	0,02039	0,01	0,010386	0,001039	9,997	ATTENTION
755.623	52		95	81	0,00883	0,01	0,001170	0,001039	1,126	
812.123	52		96	64	0,00698	0,01	0,003023	0,001039	2,910	
968.823	52		97	108	0,01177	0,01	0,001774	0,001039	1,707	
968.225	50		98	92	0,01003	0,01	0,000029	0,001039	0,028	
967.408	40		99	92	0,01003	0,01	0,000029	0,001039	0,028	

As easily observed, Table 1 has 11 columns, which indicate the statistical lean accounting implementation on CST Company. Amount column shows the sums of 120 Accounts Receivable records belonging to the CST firm. Actually, research data include 9173 observations. In other words, data cover 9173 Accounts Receivable sums as total universe. However, it is decided to only select and show 100 observations (100 observations of 120 Accounts Receivable sums) as a sample since it is impossible to list and present all the 9173 observations in this study.

Thus;

Total Universe (U) = 9173

Sample Size (S) = 100

Then, Table 1 has the 2 Digits on Right Column. This column shows the last two digits (two digits on right) of amount column. As an example, for 60.514,76 TL sum written on the amount column, 2 Digits on Right Column reflects a value of 76. Using the same logic, 74 is highlighted for an accounts receivable sum of 60.291,74 TL taking place on the amount column.

Moreover, total frequency column shows the number of 9173 on the first line. The reason is that, total data set includes 9173 observations (9173 accounts receivable sums) as mentioned before. Observation No. column indicates the observation number. Each 120 Accounts Receivable sum is statistically an observation for research. Thus, each 120 accounts receivable sum is assigned a unique code as observation number, starting from 0. For instance, since 60.514,76 TL is the first 120 Accounts Receivable sum, it is coded as 0 on Table 1. Also, since 60.291,74 TL is the second 120 Accounts Receivable sum, it is coded as 1 on Table 1. Codes for the following observations (120 Accounts Receivable sums) continue progressively based on the same logic. Concerning observed frequency column, it shows how many times two digits on the right number is repeated among 9173 observations. For example, two digits on the right of 60.514,76 TL sum is 76 and the first line of observed frequency column (789) shows us that, number 76 is repeated 789 times in a total of 9173 observations.

Then, observed rate is calculated by dividing the observed frequency to total number of observations. For example, considering observation 0, observation frequency is 789. Thus, if we divide 789 by 9173 (total number of observations), we find 0,0860133 as observed rate for observation 0. Expected rate is 0,01 (1%) for all observations as seen on Table 1. This is because 2 digits on right can be between 0 and 99. In other words, there are 100 different possibilities here. But since 2 digits on the right is a single unique number for each separate observation, probability rate (expected rate) is always 0,01 = 1/100 = 1%. Absolute difference is the absolute value of difference between observed rate and expected rate. For example, considering observation 0, absolute difference equals to 0,0760133, which is absolute value of 0,0860133

(observed rate) – 0,01 (expected rate).

After that, standard error is computed by taking the square root of 0,01 (expected rate) multiplied by 1 - 0,01 and divided by 9173 (total number of observations). In this case, for observation number 0, standard error equals to the square root of 0,01 multiplied by 0,99 and divided by 9173. The next column (z value) is calculated by dividing absolute difference to standard error. Finally, the check column gives an attention to lean accounting practitioners if the z (value) is greater than 3. Lean accounting practitioners should check the 120 Accounts Receivable sums which are labeled with attention. The mentioned 120 Accounts Receivable sums can be subject to error, fraud and defect. It is wise to analyze and investigate all such 120 Accounts Receivable sums (invoices) and this task should especially be run by auditors, accountants and lean accounting practitioners. As the CST Company progresses on the lean implementations and becomes more lean inclined, invoices (sums) subject to error, fraud and defect will decrease by the help of this statistical application.

Math Equations and Formulas for Statistical Lean Accounting Application of CST Company:

Observed Rate = Observed Frequency / Total Number of Observations (Total Universe) (1)

Expected Rate (Expected Probability) = 1 / 100 (2)

Absolute Difference = Absolute Value (Observed Rate - Expected Rate) (3)

Standard Error = Square Root (Expected Rate X (1-Expected Rate) / Total Frequency) (4)

Z (Value) = Absolute Difference / Standard Error (5)

Excel Equations and Formulas for Statistical Lean Accounting Application of CST Company:

(Example: Observation Number 0 - Line 2)

2 Digits on Right = VALUE(RIGHT(ROUND(A2*100;2);2)) (6)

Total Frequency = ROWS(A2:A9174) (7)

Observed Frequency = COUNTIF($B$2:$B$9174;F2) (8)

Observed Rate = G2/9173 (9)

Expected Rate = 1/100 (10)

Absolute Difference = ABS(H2-I2) (11)

Standard Error = SQRT(I2*(1-I2)/$E$2) (12)

Z (Value) = J2/K2 (13)

Check = IF(L2>3;"ATTENTION";"") (14)

It should be noted that, the Excel equations and formulas listed above are just examples for Observation Number 0, Line 2. Logically, Excel equations and formulas will automatically change for following observations and lines. CST Company has 9173 invoices (sums) for 120 Accounts Receivable records. Thus,

these Excel equations and formulas can easily be executed for all the 120 Accounts Receivable sums.

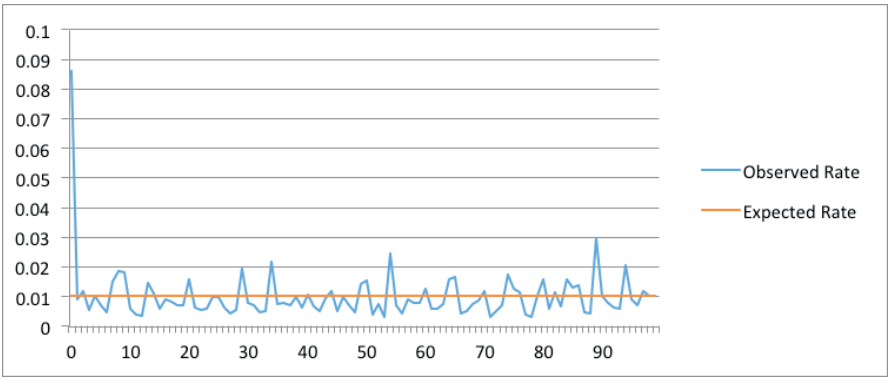

Figure 1. Comparison of Observed Rates and Expected Rates

Figure 1 shows a comparison of observed rates and expected rates. Observed rates are drawn with a line in blue color and expected rates are drawn with a line in red color. Also, the X Axis of Figure 1 reflects the observation numbers and Y Axis of Figure 1 reflects the observed rates as well as expected rates mathematically.

Statistical lean accounting implementation on CST Company has shown that, 58 invoices (sums) out of 100 invoices (sums) can be subject to error, fraud and defect. If we have a look at the CHECK column and count the total number of ATTENTIONS, we see that 58 observations out of 100 are labeled with the word ATTENTION. This is a significant proportion (ratio), which is equivalent to 58%. Thus, we have a strong indicator here proving that statistical and mathematical approaches integrated into lean accounting practices can help companies seriously to detect errors, fraud and defect. Such errors, fraud and defect affect the profitability, efficiency and competitiveness of firms. They can even harm the reputation and image of organizations. Moreover, companies can face tax penalties and legal problems. Thus, it is best to go lean for eliminating disadvantages in the industry and market.

4.Conclusion

Lean accounting should be accepted and adopted as a core business strategy for companies operating in a wide spectrum of sectors. Traditional accounting is still used highly by firms belonging to all sectors. However, it cannot satisfy the needs and necessities of modern businesses which strive to be flexible, work with low levels of inventory, eliminate waste and avoid unnecessary procedures. Since these modern companies are also motivated to decrease idle capacity, lean accounting can also be applied to financial accounting, managerial accounting and cost accounting.

In fact, firms should take lean accounting one step further and form a lean management system.

This means that, lean transformation must be completed by organizations for ideal results. Information, document and report flows will be rapid by adopting lean accounting and lean management. Employees are much focused on daily tasks and operational issues in today's business world. On the other hand, implementation of lean accounting and lean management will help employees to concentrate on strategic goals of firm.

Statistical lean accounting implementation using mathematics and software such as Excel can be done on a variety of accounting processes like accounts payable, accounts receivable, payroll, cost accounting, managerial accounting and expense reporting. This study did run a statistical lean accounting implementation especially on accounts receivables of a construction company called as the CST firm for this research. Excel and mathematical formulas were used, in addition to taking advantage of a table and graph (figure). Paper clearly shows that, statistical lean accounting implementation on CST firm was very beneficial and helpful. The reason is that, it helped to detect and label 58 Accounts Receivable records out of 100 as in attention status (risky). According to the statistical lean accounting practice of this research, the mentioned 58 Accounts Receivable records can be subject to error, fraud and defect. So, these records must be investigated and analyzed closely.

Research findings are in line with some former literature such as Womack and Jones (1994), who had claimed that lean accounting increases capacity, expedites the process so that extravagant losses can be prevented, eliminates errors and mistakes and disambiguates the process and makes it understandable. Study results are also parallel to Kocamış (2015), who had underlined the fact that lean accounting motivates lean thinking in the long-term as it concentrates on lean based information and statistics. Plus, research findings support the former findings of Cokins (2009), who had defended that lean accounting vision is comprised of providing accurate, timely and understandable information, encouraging lean transformation organization-wide and increasing customer value, decision-making on growth, profitability and cash flow, preserving comprehensive financial control while using lean tools to prevent extravagance in accounting procedures, full compliance of Generally Accepted Accounting Principles (GAAPs) with external reporting arrangements and internal reporting conditions, supporting of lean culture by the investors, procurement of relevant and triggering information as well as reinforcing constant improvement at every level of the organization. Finally, Kabene (2011) had previously stated with his research that lean principles are frequently used in industries such as informatics, construction and healthcare. That study proves and supports this fact, by clearly presenting that a lean accounting implementation helps a construction firm named CST Company in the context of this research.

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