

# The Integration of Lean Accounting and Activities-Based Public Budgeting for Improving the Firm's Performance

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The research aims to determine the level of integration between lean accounting and activity-based public budgeting for providing useful information to evaluate the public sector firm performance. Followed the analytical method using a statistical questionnaire depended on the individuals of the research sample represented by accounting, administrative, technical, engineering staffs. The research sample consists of (55) individuals in the public sector for hypothesis testing, the statistical software (SPSS) used. The research hypothesis was tested and accepted after calculating a set of statistical measures such as arithmetic mean, standard deviation, coefficient of variation, and percentage weight. Findings significantly showed that lean accounting integrated with activity-based public budgeting for public firm performance evaluation indicators. The most important conclusions were that the integration between lean accounting and activity-based public budgeting leads to providing financial and non-financial information to improve the efficiency of performance evaluating in public firm. This integration supports managers to decrease the idle capacities and generate important recommendations which improve the public sector firm's performance in future.

**Key words:** *Lean Accounting, Activity -based Public Budgeting, Firm Performance, Public Sector.*

## Introduction

In public sector companies, the traditional cost systems are not able to meet the requirements of lean production in the light of the modern business environment, that the lean production is based on the philosophy of economy in everything and eliminate all kinds of waste and loss, and lean Accounting is one of the most important tools for continuous improvement in the modern business environment, the lean term is a set of tools that help in determining waste and exclusion. Wastes affect the value and quality of the achieved work while lean accounting reduces the cost and time of production. Recently, the Firm has adopted a lean accounting approach that develops and improves work to reduce cost, meet customers' desires and improve the quality of the firm's products (Maskell & Kennedy, 2007). Activity-based Public Budgeting is the planning and controlling process of the expected activities of the firm to derive the sufficient budget of the costs to determine the expected work and achieve the objectives of the firm and aims to determine the requirements of the necessary activities to accomplish the tasks of firm and determine the volume of the necessary resources and thus is a useful tool for evaluating performance, Especially the modern production systems, including lean production (John, 2005). The problem of research is the lack of traditional systems of performance evaluation based on traditional cost accounting indicators and measures in the current production environment to meet the requirements of evaluating and improving the performance of the firm. Therefore, the lean production system is easy to apply some modern accounting practices such as lean accounting and activity-based public budgeting to improve the evaluation efficiency of its performance and knowledge of the strength and weakness of firm. The problem of study posed according to the following two questions: Is it possible to overcome the shortcomings in evaluating the performance of the firm using lean accounting and activity-based public budgeting? Does the integration between lean accounting and activity-based public budgeting lead to improve the performance evaluation efficiency?

The research aims to identify the knowledge bases of some modern accounting practices such as lean accounting and activity-based public budgeting. Determining the possibility of the integration between lean accounting and activity-based public budgeting to provide appropriate information to evaluate the performance of the firm in light of the adoption of the lean production system. The importance of research stems from the fact that it deals with the most important modern accounting practices that contribute to improving the performance evaluation indicators of the firm which lead to improving the quality of the products, maximising the value provided to customers, gaining the competitive advantage and the role of these practices in determining the volume of necessary activities to achieve the objectives of firm and to determine the volume of the resources required, It is an excellent tool for planning, control, decision making and performance evaluation.

## Literature Review

The part shows some related studies which provide a theoretical base. Wang & Yuan, (2009) Studied Lean Accounting Based on Lean Production. The aim of study is to compare lean accounting and classical or traditional accounting, in addition, to use the value stream to eliminate waste in production, reduce costs, improve quality and gain competitive advantage. Mishra & Pradhan, (2010) examined Lean Accounting: A Recent Development in Management Science. The study aims to replace the traditional cost and managerial accounting systems with lean accounting, avoidance of waste, cost reduction, quality improvement and increased flexibility to meet competitive market demands. Ademirli,(2010) Studied Activity Based Budgeting Case Study about ABB Usage. The purpose of the study is to provide a clear explanation for the importance of the ABB use for a company in the Netherlands, as well as a good means of communication and control within the firm and control of costs in a highly competitive environment. Huynh & et al., (2013) tried to examine an Integration of Activity Based Public Budgeting and Activity-Based Management. This study aims to develop an ABB model with ABM to overcome the limitations of managerial accounting methods application. This integration focuses on both the actual results and the preparation of the budget based on these results, which gives managers a comprehensive view of the firm results and helps them in assessing the responsibilities of all management levels.

The concept of lean term is the economy in everything from the needs or requirements of production since the production requires less human resources and less time to prepare the new product and lower cost of equipment and tools, less inventory in the factory, the less defect, the diversity of products and economy in the requirements of production by eliminating waste and reduce Demand time ...etc. (Shah & Ward, 2007). The lean approach of management is to find ways and methods that are less wasteful and time-consuming to create value from a customer's perspective and to reduce waste of operations by delivering the same value to customers at the lowest cost (Amusawi, Almagtome & Shaker, 2019), (Lawrence, 2005, 18). There are several definitions of Lean Accounting (LA), the most important are: - The method aimed at supporting and encouraging lean manufacturing in order to avoid obstacles, difficulties and errors in work and the need for changes in production costs when moving from the traditional production system to the lean production system by calculating the Value Stream (Hansen et al., 2009). It is also known as: - A professional approach to business management based on the principles of lean management and lean production that provide the appropriate basis for the use of accounting information that supports lean in production and management in order to support cost management, value chain activities and eliminate waste of accounting systems applied in firms (Gamal, 2011). It is also part of an integrated system and administrative method that has become common in the field of work in recent years, which provides the reports and analysis of the values and reducing the differences in production costs, operations, employment, equipment... etc. (Richard & Karen, 2007). The analysis unit of all the above literature is public firm, and the

incentive interesting is an economic incentive. If so, how to ensure that the public firm process is efficient?

The real reason is the decision-making responsibility of the public firm for enhancing a performance evaluation (Bulut-Cevik et al.,2019), (Kbelah, Amusawi & Almagtome, 2019). While Guan, et al. (2009) argued which costs are prepared and designed according to the value chain concept, which collects both financial and non-financial information in order to provide the firm with financial statements that reflect performance using quantitative and qualitative information (Guan et al., 2009:405). While (Horngren & et al.) defined it as: - The method that supports the creation of value for customers by calculating all costs of value streams rather than calculating the costs of specific products or individual department and thus eliminating all kinds of waste in activities (Horngren et al,2012). (Maskell & Baggaley) is defined as: - A system that produces the firm with relevant information to make decisions that lead to increase returns and cash flows by using a set of tools and techniques such as Value Stream Mapping (VSM), Box Scores (BS)...etc. to eliminate waste and non- value-added activities(Maskell & Baggaley, 2006). The following definition of lean accounting technique can be formulated: A method designed to apply the concepts of lean production to reflect the better financial performance of the firm and work to eliminate all losses and wastes in production processes in addition to its dependence on the value stream, methods of inventory assessment, specifications and quality of products and other non-financial information. The difference points between classical or traditional accounting and lean accounting, as shown in table (1):

**Table 1:** The Differences Between Traditional Accounting and Lean Accounting

| <b>Lean Accounting</b>   | <b>Traditional Accounting</b>                                       |
|--|---|
| 1. Includes simple and quick operations.                         | 1. Include complex and large operations.                            |
| 2. The cost object is the value stream.                          | 2. The cost object is the product.                                  |
| 3. Value stream indicators contribute to decision-making.        | 3. Reports of standard variances contribute to decision-making.     |
| 4. The continuous improvement method is used to decision-making. | 4. Differential cost analysis is used to assist in decision-making. |
| 5. Pricing based on value.                                       | 5. Pricing based on cost.   |
| 6. Focusing on financial and operational performance.            | 6. Focusing on financial performance only.                          |
| The inventory is little or no.                                   | 7. The inventory is large.  |
| 8. The culture of a firm is based on cooperation and equality.   | 8. The culture of firm is based on control and leadership.          |

**Source:** (Vineeta,2016; Qingmin & Lin,2009)

There are many tools and methods of lean accounting application the most important such as Value Stream Mapping, Target Costing, Kaizen, Box Scores, Hoshin Policy, Low Inventory, and

Sarbanes Oxley Risk etc. (Maskell & Baggaley, 2006). The using of the ABC technique for budgeting is called ABB. The cost of the resources consumed by the activities expected to be achieved in the firm is determined. This type of budget focuses on understanding the activities and recognizing their impact on achieving the strategic objectives. Diversity and difference in operations resulting from the requirements of certain products or services in the firm and leading to cost management and forecasting (Brimson & Antos, 1999). ABB is a modern budgeting method that shows the relationship between the production volume and the activities needed to produce these production units and to provide accurate estimates of the activities needs for the suggested production plans (Kaplan et al., 2007). There are several definitions of Activity Based Budgeting (ABB) technique; the most important are: Quantitative expression of inflows and outflows that seek to draw future plans of the firm and achieve their objectives (Atkinson et al., 2004). While (Balick) defined it as "the correct and proper use of firm resources to support key activities proportional with the volume of these activities" (Balick, 2010). It was also defined as:

- One of the methods of preparing the budgets used by the firm to understand its activities and its relation to the cost drivers to quantify the required resources as part of a continuous work plan (Gosselin, 2007). While (Julia) defined it as: - A method similar costing (ABC) approach and activity-based management (ABM) approach involving planning and control in line with the value-added - activities and processes (Julia, 2011: 28). The researchers can provide the following definition of ABB technique: One of the modern approaches in the process of preparing budgets that focus on employment the activities of the firm to provide products according to the customers' desires, the cost and quality required. The integrating of lean accounting within activity-based public budgeting supports an efficiency of performance evaluation: The implementation of lean philosophy requires the introduction of new procedures on the process of performance evaluation, which allows the planning and control processes of activities and operations continuously, which is what ABB technique aims at creating the link between the work cell and the value stream on the one hand and the objectives of firm on the other hand. The evaluation of the performance in accordance with the methods of lean thinking is not only based on financial indicators and measures but should be supported by operational indicators and this requires the involvement of all workers in the evaluation process with the aim of continuous improvement of all administrative levels in the firm and this is what is intended by the ABB technique (Kennedy & Brewer, 2005), (Lopez & Santos, 2010). Lean production firm cannot ignore the legal, financial statements and should look for an accounting method or system that can identify and measure the financial and operational improvements of its operations, the practices followed by the lean firm and impact on the ABB as follows:

- The inventory of raw materials and work in process in the lean firms less than the firms that follow the traditional production system and their volatility is less because it schedules the lean production and the inventory is not followed up but only appreciated.
- Indirect factory overhead costs are not used to estimate the quality of the production process because they are managed by the individuals responsible for them.

- There is no need to follow the changes in prices because the production on demand and statements of payments equal the labour costs of the goods sold.
- Reduce the paperwork which does not add value and there is no need to prepare reports on the performance of individuals or departments because the production is adapted to the demand and there is no one leads to work less or more than the specified.
- It is increasing the accuracy of allocating indirect factory overhead costs by using the cost of raw materials and labour together, not only the cost of labour, and also allocating the depreciation according to the working hours of the machine.

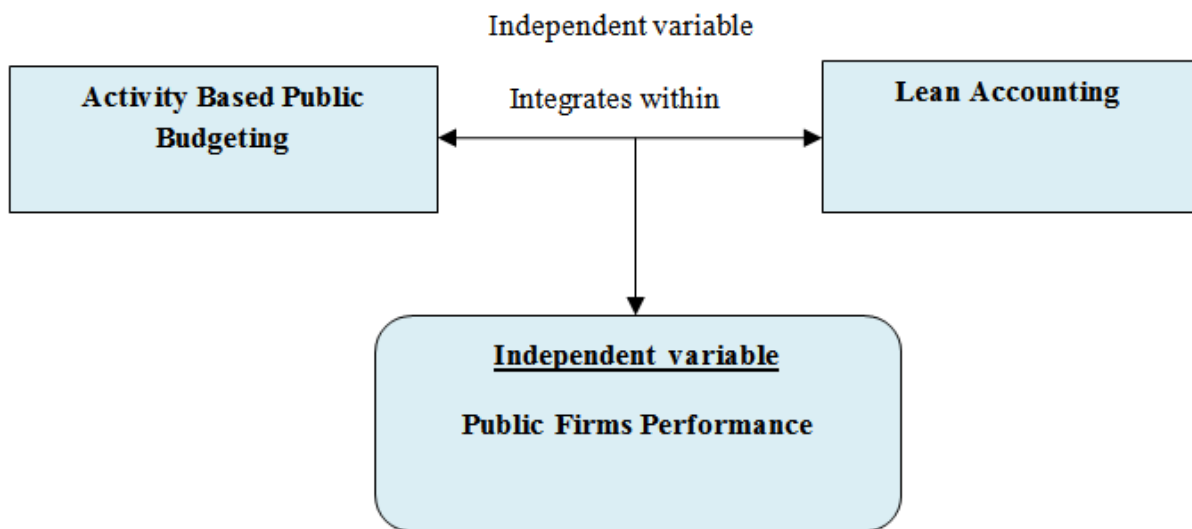
Hence, the need to adapt the ABB technique with lean production and to solve the problem of the lack to cost accounting to adapt to the new production models has been using ABC technique. Indirect costs are significant in many firms compared to direct costs. Therefore, the ABC technique helps to calculate the costs correctly and according to the activities that are inputs to the ABB technique, which allow to follow up the waste and loss of resources. This is one of the lean production pillars which improves the efficiency of evaluating the firm performance and helps in determining indicators of operational improvement and benefits. ABB and lean production make it possible to redesign processes and activities, lead to cost management and reduce costs.

## **Research Methodology**

- ***Research hypothesis***

This study depends on a basic hypothesis is that the integration of lean accounting and activity-based public budgeting leads to improve the efficiency of public firm performance evaluation indicators based on the lean production system.

**Figure 1.** Research model



- **Sample of the Study**

The sample contains (55) distributed form among the accounting, administrative, technical, engineering and production designers' staffs at Cement Factory of Najaf as a public sector company. The period of application for the questionnaire during 10/2018-12/2018. Cement Factory of Najaf is one of the factories belonging to the General Company for Southern Cement, which is one of the formations affiliated to the Ministry of Industry and Minerals. It is located in Najaf province, 7 km south of Kufa city centre. It was established by India ACC company in several production lines for the produce Portland Cement resistant to salts has reached the number of employees to more than (500) employee, as we note the extent of absorption for a large number from human resources and its contribution to the creation of jobs for citizens.

- **Materials**

Based on the results presented by the questionnaire forms and after analysing the data obtained by analysing the responses of the individuals from the study sample of the study community from accountants, administrators, engineers, designers...etc. , and to describe and diagnosis the most important research questions of the hypothesis in order to identify the different opinions of the individuals. The researchers used the Likert criterion to conduct the statistical analysis for these questions and to test the research hypothesis, which states that: (The integration of lean accounting and activity-based budgeting leads to improve the efficiency of public firm performance evaluation indicators based on the lean production system).



**Table 2:** Indicators of individual responses for hypothesis testing

| # | Items  | Statistical Indicators   |                    |                         |                |
|---|--|--------------------------|--------------------|-------------------------|----------------|
|   |  | weighted arithmetic mean | Standard Deviation | Coefficient of Variance | Weight Percent |
|   | The integration of lean accounting and activity based public budgeting contributes to more control effectiveness of resources consumed and the identification of idle capacity.            | 3.745                    | 1.280              | 34.168%                 | 74.909 %       |
|   | Provide information on the activities required to carry out the tasks of the firm and then determine the amount of resources consumed.   | 3.821                    | 1.157              | 30.274%                 | 76.429 %       |
|   | This integration helps identify that value added -activities and non-value added-activities and it leads to reduce costs and improve the performance of activities.                        | 3.339                    | 1.202              | 35.982%                 | 66.786 %       |
|   | This integration increases the accuracy of cost allocation, providing relevant and reliable information for planning, control and performance evaluation.                                  | 3.929                    | 1.029              | 26.203%                 | 78.571 %       |
|   | Provides the possibility of identifying the firm's needs from resources and how to optimize its utilization.   | 4.089                    | 0.933              | 22.805%                 | 81.786 %       |
|   | The need to provide a highly flexible accounting system that is appropriate to the changes surrounding the firm to keep developments in the field of strategic cost management techniques. | 4.125                    | 0.983              | 23.822%                 | 82.500 %       |
|   | This integration helps firm to develop financial and productive plans through which sources of access to resources and at the lowest cost.   | 4.036                    | 1.041              | 25.803%                 | 80.714 %       |
|   | Participation of employees at all administrative levels in drawing plans and setting goals in line with each level of the public firm.   | 4.143                    | 0.951              | 22.944%                 | 82.857 %       |



|  |       |       |         |          |
|--|-------|-------|---------|----------|
| This integration encourages continuous communication with customers to know their wishes and requirements.   | 4.071 | 0.983 | 24.142% | 81.429 % |
| The integration of lean accounting and activity based public budgeting helps to provide the necessary information on financial and non-financial indicators and measures to improve the efficiency of performance evaluating in public firm.               | 4.554 | 0.570 | 12.507% | 91.071 % |
| This integration helps to spread the culture of eliminating waste and loss and avoid non value added activities among workers.   | 4.214 | 0.805 | 19.109% | 84.286 % |
| Follow-up all the activities necessary to obtain this product from the beginning of the order receipt until the product delivery under this integration, which further improve the indicators of the performance efficiency evaluation of the public firm. | 4.250 | 0.814 | 19.152% | 85.000 % |
| General average  | 4.026 | 0.979 | 24.742% | 80.528 % |

## Results and Discussions

The results in Table (2), which includes (12) questions, indicate that the general response rate of the sample was 80.528% with a weighted average of 4.026 and a standard deviation 0.979 and a Coefficient of Variance 24.742%. The most important paragraphs that contributed to enriching this variable are the tenth paragraph: (The integration of lean accounting and activity-based public budgeting helps to provide the necessary information on financial and non-financial indicators and measures to improve the efficiency of evaluating the firm performance). The severity of the response 91.071% with a weighted average 4.554 and a standard deviation 0.570 against the coefficient of Variance 12.507%. The following paragraph is (12): (Follow-up all the activities necessary to obtain this product from the beginning of the order receipt until the product delivery under this integration, which further improves the indicators of the performance efficiency evaluation of the firm). The severity of the response was 85% with a weighted average 4.250 and a standard deviation 0.814 against a coefficient of variance 19.152%, while the lowest percentage in this variable is for the third paragraph: - (This integration helps identify that value-added -activities and non-value added- activities and it leads to reduce costs and improve the

performance of activities), The severity of the response 66.786% with a weighted average (3.399) and a standard deviation 1.202 against a coefficient of variance 35.982%. It is noted that the weight percentages of most the paragraphs exceeded (70%) and that the arithmetic means of the sample exceeded the default mean of the measurement performance (3) at a significant level (5%), degree of freedom (54) and all the research variables.

**Table 3:** T test Results of the research variables

| Variables      | 1   | 2   | 3    | 4   | 5   | 6   | 7   | 8   | 9   | 10   | 11  | 12   | Average |
|----------------|-----|-----|------|-----|-----|-----|-----|-----|-----|------|-----|------|---------|
| Calculated (t) | 4.3 | 5.3 | 2.11 | 6.7 | 8.7 | 8.5 | 7.4 | 8.9 | 8.1 | 20.4 | 11. | 11.4 | 8.633   |
| Tabled (t)     | 1.6 | 1.6 | 1.67 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.67 | 1.6 | 1.67 | 1.673   |
|                | 20  | 13  | 3    | 50  | 41  | 67  | 43  | 97  | 57  | 14   | 284 | 92   |         |
|                | 73  | 73  | 3    | 73  | 73  | 73  | 73  | 73  | 73  | 3    | 73  | 3    |         |

(df= 54, significant level 5%)

It appears from the table above that the calculated value of (t) is greater than the tabled value of (T) for the degree of freedom (54) and the significant level (5%) for all the research variables as well as the general average of these variables where the calculated value of (T) amounted to (8.633) is greater than the tabled value of (T) amounted to (1.673) of df=54 at level 5%, which leads to acceptance of the research hypothesis, which states that: The integration of lean accounting and activity-based public budgeting leads to improve efficiency of firm performance evaluation indicators based on the lean production system.

## Conclusions

This study interests to investigates the integration between lean accounting and activity bases public budgeting leads to the provision of financial and non-financial information to improve the performance evaluation efficiency of the public sector firm. This integration helped in spreading the culture of the eliminate waste and loss among the firm staff. Achieving the optimal utilisation of resources and determine the amount of idle capacity found as a result of the integration. The statistical analysis results of the research showed that the general average of the research hypothesis variables in which the calculated value of (T) amounted to (8.633) is greater than the tabled value of (T-test) amounted to (1.673) with degree of freedom (54) and significant level (5%). Acceptance of this hypothesis, which states that: The integration of lean accounting and activity-based public budgeting leads to improve the efficiency of public firm performance evaluation indicators based on the lean production system. Improving performance indicators to achieve the optimal utilisation of resources, reduce costs and increase the firm productivity. Finally, the research recommended that work on the establishment of a database that contributes to the provision of all information to apply lean accounting and activity-based public budgeting techniques. Obtain support from top management to implement this integration and encourage



employees to implement it. Holding training courses to develop the skills and experience of the general firm staff to apply the lean accounting and activity bases public budgeting.



## REFERENCES

- Ademirli, S., (2010). Activity Based Budgeting Case Study about ABB Usage, Master thesis, College of Economics & Business, Amsterdam, Netherland.
- Amusawi, E. G., Almagtome, A. H. & Shaker, A. S. (2019). Impact of Lean Accounting Information on The Financial performance of the Healthcare Institutions: A Case study, Journal of Engineering and Applied Sciences, 14(2), 589-399.
- Atkinson, A. & Robert, S. & Kaplan, S. (2004). Management Accounting" 14th Ed., Prentice Hall, USA.
- Balick, Bruce, (2010). Activity-Based-Budgeting: Preview of Academic Impacts For U.W. Faculty, Chair of The Faculty Senate, 10 March.
- Brimson, James & Antos, John (1999). Driving Value Using Activity-Based Budgeting, John Wiley& Sons INC., Canada.
- Bulut-Cevik, Z.B., Sen, H. and Kaya, A., (2019). The Khaldun-Laffer Curve Revisited: A Personal Income Tax-Based Analysis for Turkey. Transylvanian Review of Administrative Sciences, No. 56 E, pp. 132-148
- Gamal, S. (2011). Lean Manufacturing Basics, P: 8, [www.Devisland.net](http://www.Devisland.net).
- Gosselin, M. (2007). A Review of Activity Based Costing: Technique, Implementation & Consequences, Handbook of Management Accounting Research, Vol. 2, Amsterdam, Elsevier.
- Guan, L.,& Hanson, D. & Mohryn ,M., (2009). Cost Management", 5thEd., Swiy, South-Western India.
- Hansen, D. & Mowen, M. &Guan, L. ,(2009) .Cost Management: Accounting and Control, 6th Ed., South-Western, a part of Cengage Learning.
- Horngren, Charles T., & Foster, George & Datar, Srikant M., (2012). Cost Accounting A Managerial Emphasis, 14thEd., Prentice – Hall Inc., New Jersey.
- Huynh, Tandung & Gong, Guangming & Huynh, Huyhanh (2013). Integration of activity-based budgeting and activity-based management, International Journal of Economics, Finance and Management Sciences, Vol.1, No.4, p: 181-187.
- John, Antos, (2005). Activity Based Management, Activity Based costing, Activity Based Budgeting, Value Creation Group Inc, December.



- Julia, A., (2011). Budgeting & Budgetary Control as Management Tools for Enhancing Financial Management in Local Authorities, Afigya Kwabre District Assembly as a Case Study, A Master's Thesis in Business Administration, Kwame Nkrumah University of Science & Technology.
- Kaplan, Roberts S. & Atkinson, Anthony A. & Matsumura, Ella Mae & Yong, Mark S., (2007) "Management Accounting" , Prentice Hall, USA.
- Kbelah, S. I., Amusawi, E. G. & Almagtome, A. H. (2019). Using Resource Consumption Accounting for Improving the Competitive Advantage in Textile Industry, Journal of Engineering and Applied Sciences, 14(2), 575-382.
- Kennedy, Frances A. & Brewer, Peter C., (2005). Lean What's It All About?", Accounting & Strategic Finance, Vol. 87, Issue 5, p: 26- 34.
- Lawrence P. Grasso (2005). Are ABC and RCA Accounting Systems Compatible with Lean Management? Management Accounting Quarterly.
- Lopez, Patxi Ruiz deArbulo & Santos, Jordi Fortuny, (2010) .An Accounting System to Support Process Improvement : Transition to Lean Accounting , Journal of Industrial Engineering and management , November,P: 576 – 602, Spain .
- Maskell, B. H. & Baggaley, B. I., (2006) "Lean Accounting what is it all about?" from Lean Accounting Summit in September.
- Maskell, B. H. & Kennedy, F., (2007). Why do we need lean accounting and how does it work? , Journal of Corporate Accounting & Finance, March- April, P:59-73.
- Mishra, K. & Pradhan, B. (2010) Lean Accounting: A relent Development in Management Science, Amusandhan University Orissa.
- Qingmin, yuan & Lin A., (2009). Lean Accounting Based on Lean Production, article, P: 3.
- Richard.E & Karen.M, (2007) Lean Accounting Fad or Fashion, Unpublished doctoral dissertation, Appalachian State University, North Carolina,USA.
- Shah, Rachna & Ward, Peter (2007). Defining & Developing Measures of Lean Production, Operation Management Journal, 25(4).
- Vineeta, Arora, (2016). Lean Accounting: A Case Study of Selected Enterprises in India, Department of Accountancy & Statistics, Faculty of Commerce, Mohanlal Sukhadia University, Udaipur, India.



International Journal of Innovation, Creativity and Change. [www.ijicc.net](http://www.ijicc.net)  
Volume 11, Issue 6, 2020

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Wang, Lin & Yuan, Qingmin, (2009). Lean Accounting Based on Lean Production.  
[www.ieeexplore.ieee.org](http://www.ieeexplore.ieee.org).