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## Title: “Effect of Kanban and Kaizen on Toyota’s Manufacturing Costs”

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### ABSTRACT

*In the last decade, inventory control has been on the focus of all the manufacturing firms across the world. In order to ensure inventory control, firms have developed many inventory control techniques. But to what extent to these techniques help in fulfilling their primary objective of cost minimization is a real question that needs to be answered. Hence, the paper attempts to answer the question. The aim of the study is to study the effects of Kanban and Kaizen on reducing the manufacturing costs of manufacturing costs of the firms. If closely monitored, one can observe that Toyota is the company which has concentrated and contributed towards inventory control and therefore the sample chosen for the study is Toyota. The variables considered for the study are manufacturing costs and the inventory turnover ratio. The periodicity of the study and the data analyzed will be from the financial year 2012-13 to the financial year 2014-15. The statistical tools used for the study are the Pearson correlation and the ratio analysis. The limitation of the study is that, the study pertains to only one company.*

**Keywords:** KANBAN, KAIZEN, COST MINIMIZATION.

### 1 a. INTRODUCTION

Founded in 28<sup>th</sup> August 1937, by Kichihiro Toyoda, Toyota is one of the largest automobile manufacturers across the globe. It is among the top 10 largest companies by revenue as of October 2016, and is the world’s largest automobile manufacturer. This world-wide giant houses as much as 364,445 employees as of March 2017.

Toyota is also the world’s market leader for sales of hybrid electric vehicles and one of the largest companies to encourage the mass-market adoption of hybrid vehicles across the globe. It is also the first ever company to manufacture an amount of vehicles exceeding that of 10 million vehicles per year which it has done since 2012, when it also reported the production of its 200<sup>th</sup> millionth vehicle.

The total cumulative global revenue of Toyota and Lexus hybrid passenger car models achieved the 10 million milestones in January 2017. Its Prius family is the world’s top selling hybrid nameplate with over 6 million units sold worldwide as of January 2017.

The concept of Lean manufacturing system or ‘Just-In-Time (JIT) system, is a vehicle production system that was formulated by Toyota Moto Corp which focuses on the “complete elimination of all waste” imbuing all aspects of production in pursuit of the most effective and efficient production methods. Since then it has gotten the recognition, and is being studied globally.

Just-in-Time strictly follows the slogan “make only what is needed, when it is needed, in the amount it is needed’. This way, Toyota Production System strives to eliminate all wastage involved in the process of production through continuous improvement.

Kanban is a Japanese word that has many meanings that can be inferred from it. Literally, it means “visual card’. It is a very popular method implemented in Toyota to improve their production and manage it more efficiently. This term in Toyota, is used for physical and visual signaling system that bundles the Lean Production System together. Though Kanban is traditionally used for physical assembly line production, however, now it is being implemented in software as well.

Kanban has 3 main elements. Visualizing the workflow, limiting the Work in Progress and Measuring the Lead Time.

Visualizing the workflow includes dividing the workflow into small tasks and then putting a label on the walls to ease the understanding of the entire flow. Limiting the Work In Progress include assigning a standard limit as to how many product unit should be in the production flow (progress) at each workflow state. Lead time means the average time to complete one item. It is also known as cycle time. This element is concerned with the efforts put into optimizing the entire production flow to minimize the lead time as much as possible.

Kanban has many benefits such as reduced inventory thus helping in reducing inventory holding costs. Furthermore it ensures the improvement of the work flow. Furthermore, it prevents overproduction, improves responsiveness to changes in demand. Moreover, it minimizes the risk of obsolete inventory, because inventory is only created as it is needed.

Kaizen is a Japanese word, which literally means “change for the better”. It is a Japanese philosophy that is focused on making continued constant improvements. The core concept emphasises that there will always be room for improvement. Kaizen aims to improve the entire production process by eliminating all waste and excess.

Kaizen depends upon the visual array of the space. Precise and clear markings are a necessary element of Kaizen.

Kaizen is a long term process that needs to be supported from the very top to the bottom, and the other way around. It is not a one-time event, but rather a long run process. The 4 basic steps of Kaizen is rather simple to understand and self-explanatory. They are planning, doing, checking and Acting respectively.

#### **1 b. OBJECTIVES OF THE STUDY:**

- ) To study the effects of inventory control techniques on the reduction of manufacturing costs of Toyota.
- ) To analyze if the inventory control techniques fulfill their primary objective of cost minimization.

#### **2 a. LITERATURE REVIEW:**

In a paper titled “**Inventory Management for Minimum Cost**” (1967) authored by David P. Herron discusses about the famous inventory management type, that is (Q, r) system. In the (Q, r) system Q stands for quantity of the reordered items when reached reorder point and r stands for the reorder point. However, the purpose of the article is to explain and elaborate on the graphical and numerical techniques/methods for inventory management in an organization. The author states that the techniques he proposes solves majority of limitations of the packaged computer programs such as errors for the items with higher cash flow, assumption based analysis, difficulty in the determination of the impact of service level loss on the sum of yearly cost for both the single item inventory and an aggregate inventory for N items. Author opines that irrespective of the various number of computer programs, it is often given the minimum cost values due to the usage of Wilson economic order quantity. In the later section of the article, author explains an N-item inventory with an example. Author also states that the use of the Wilson economic order quantity will increase the costs. The article emphasizes on algebraic and graphical methods which are apt for computerization. In the discussion of inventory by the author, he has included both single item inventory cases and the collective inventory cases. In conclusion author explains about how the application of methods on computers will curtail the costs and increase the savings.

“**A Single-Stage Supply Chain System Controlled by Kanban under Just-in-Time Philosophy**” (2004) written by S. Wang and B. R. Sarker talks about the framework utilizing kanban, which was spearheaded by Toyota Motor Company in Japan and in this way it was received by various other Japanese and US organizations for applying the time producing standards. Author explains how this exploration was considered a solitary stage in the production network framework that is controlled by kanban component. The article discusses about the store network framework which is displayed as a mixed-integer nonlinear programming (MINLP) issue, the issue is tackled ideally by branch-and-bound strategy to decide the quantity of kanban, group measure, number of clumps, and the aggregate amount more than one period. Then, the kanban operation between two contiguous plants is worked out thinking about the elements of stacking and emptying

time, and transport time. Combined with extensive endeavors for cost control and administration responsibility regarding improve different measures of execution, a coordinations framework for controlling the generation and also the store network framework is produced, which brings about limiting the aggregate cost of the inventory network framework. In conclusion, author demonstrates that the upgrades in reducing of inventory, squandered work and client benefit in a production network are expert through the implementation of kanbantechinque.

A paper titled “**Applications of Single-Card and Dual-Card Kanban**” (1983) written by Richard J. Schonberger is a conceptual paper which discusses about the Japanese inventory control technique called Kanban, a technique in which production of materials will be based on the kanban card and an empty container. Kanban is a pull system unlike a push system which governs schedule based systems such as material requirements planning (MRP). Since it was stated that the Kanban technique is often compare to various techniques such as MRP, and Reorder point (ROP), thus the author emphasizes on the limitations of the MRP technique and how Kanban is better than MRP. Toyota introduced a productivity improvement feature which makes it a dual-card Kanban technique. Often Kanban techniques are compared to re order point, replenishment techniques (continuous) and MRP. In the later section, the author analyses if the western industry is ready for Kanaban dual card technique, the analysis reveals that they are usually not ready but two of the America’s well known plants follow Kanbani.e., The Greenly Divksion of Hewlett Packard Corp. and the Cleveland area General Electric plant.

“**Analysis of a Kanban Discipline for Cell Coordination in Production Lines**”(1990) authored by DebasisMitra and Isi Mitrani attempt to address the functioning of Kanban. Authors have described and examined “Kanban” for the coordination of cells in a big-scale production facility. There are many cells in a tandem configuration and a set range of cards (or kanbans in japanese usage) in each cell. The cards circulate in the cell and their presence at distinct positions signals to the neighbouring cells the repute of the cellular's stock; guidelines specify the timing of the motion of parts from cellular to cell. Authors have assembled a stochastic model of the entire production facility and have deliveredtheir outcomes in three components. First, the kanban area is as compared to the classical production area and its miles shown to dominate the classical subject in terms of throughput. Secondly, they have provided a scheme for reading approximately the overall performance of the kanban system with the aid of inspecting a single cell in isolation and then combining the isolated cells via fixed-point equations. Lastly, they file on widespread experiments and on their numerical outcomes which can be received from simulations and their approach of evaluation. The throughput-inventory relationship of the kanban scheme is determined to be advanced.

## **2 b. NEED FOR THE STUDY:**

) The literature review of various studies has revealed that the authors have analyzed inventory techniques but in relation to any company.

) Even if they have analyzed with respect to a company, it is mostly conceptual papers and review works and hence the need for the study is felt.

## **2 c. HYPOTHESIS:**

### **Null hypothesis:**

Inventory control techniques usage has reduced costs of Toyota.

### **Alternative hypothesis:**

Inventory control techniques usage has not reduced costs of Toyota.

## **3. METHODOLOGY:**

### **(a) Type of research:**

The variables “Costs” and “Inventory techniques” were analyzed through secondary sources and the objectives were analyzed through library research.

**(b) Research tool:**

Quantitative method of research was adopted for the study which included the following,

- Data available on Toyota official website.
- The prevailing results of market research.

**(c) Sample design**

- ) Purposive sampling is considered for the study. The sample is chosen on the basis of the interest of various manufacturing companies in Inventory control techniques.
- ) The study is useful for all the academicians, students and manufacturers across various horizons of world..
- ) The sample includes one manufacturing company (TOYOTA) and was used to fulfill the purpose of the study.

**(d) Method for analysis:**

Correlation and ratio analysis are the tools used in the study with the help of SPSS and Excel.

**4. FINDINGS, ANALYSIS AND EVALUATION:**

YEAR	MANUFACTURING COSTS(in lakhs)	INVENTORY TURNOVER RATIO
2012-13	1.92	9.74
2013-14	1.91	10.5
2014-15	1.94	10.55

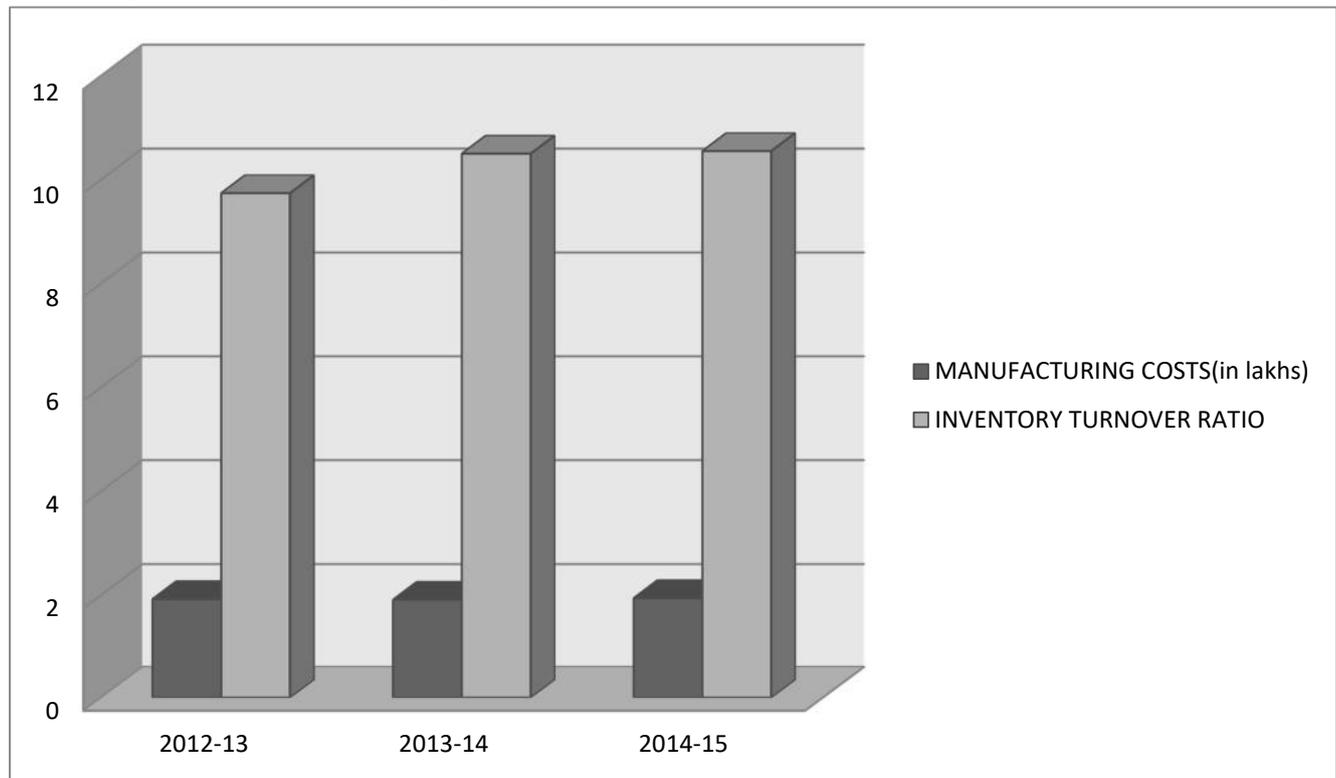
\*all the above figures are approximate values.

The above table indicates that the even with the increase in the inventory turnover every passing year, the manufacturing costs have reduced in Toyota due to utilization of inventory control techniques such as kanban and Kaizen.

**Correlations**

	MANUFACTURING COSTS in lakhs	INVENTORY TURNOVER RATIO
MANUFACTURING COSTS in lakhs	Pearson Correlation Sig. (2-tailed) N	1 .584 3
INVENTORY TURNOVER RATIO	Pearson Correlation Sig. (2-tailed) N	-.584 .603 3

When the data was analysed on SPSS, the correlation between manufacturing costs and inventory turnover turned out to be negative standing at (0.584) representing that they do not move together. And hence manufacturing costs have reduced considerably even though the inventory turnover has been increasing. The same is represented in the below graphical representation.



## 5. CONCLUSION:

Based on the analysis, inventory control techniques such as Kanban and Kaizen can minimize the costs of Toyota and have improved the inventory turnover over years. Thus, inventory control techniques reduce costs of manufacturing firms by giving them an edge by cutting on costs of manufacturing. The scope of the study would be to conduct the research for other manufacturing firms considering the other inventory control techniques.

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