

The impact of using just-in-time production technology in rapid manufacturing and attainment of customer satisfaction

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ABSTRACT

manufacturing response and customer satisfaction within juice and soft drinks manufacturing companies. Using financial and operational data covering the period 2010–2022, the research employs descriptive and analytical methods supported by statistical analysis through SPSS. The findings reveal a consistent upward trend in production quantities, sales quantities, and production supply costs over the study period. Results show a statistically significant positive effect of JIT implementation on rapid manufacturing response, where a 1% increase in JIT usage leads to a 0.025% improvement in response speed. Furthermore, JIT adoption demonstrates a significant positive influence on customer satisfaction, with a 1% increase in JIT practices resulting in a 0.300% rise in customer satisfaction levels. The study concludes that implementing JIT enhances operational efficiency, reduces waste, minimizes inventory burdens, and supports timely delivery—collectively strengthening customer satisfaction and competitive advantage. Recommendations include increasing industry awareness of JIT practices, promoting rapid response strategies, and encouraging further academic research on JIT adoption within the beverage manufacturing sector.

KeyWords : just – in time production , costumer satisfaction , Manufacturing Performance

INTRODUCTION

Since the time of its inception, the manufacturing industry has been just a little touched up by the just in time (JIT) production technology, which has helped make a business's more efficient in presenting a continuous flow of operation and a quick speed to react to the consumer needs. This technological approach has been used in most of its sectors, and its use in this case particularly in the juice and soft drinks manufacturing industry. But in this sector, the companies can apply JIT production to satisfy the customer demand, to cut the cost of inventory and to enhance the customer or overall satisfaction (Pisch, 2020).

JIT production technology is a technology based on the production of goods or delivery of services only when the goods or services need are in demand and free of storage and waste. In manufacturing juice and soft drinks manufacturing companies, this can be translated to the manufacture of finished beverages from customers' orders contrary to the practice of stockpiling large quantities of the finished products (Yao, et al 2020).

Most important merit of JIT production technology in the juice and soft drinks industry would be its ability to facilitate raddy response to customer requirements. A company watches the market trends and customer preferences closely in order to readjust its production schedules in line with the needs of people for what they need and at what time they need them. Companies that are able to rapidly take advantage of opportunity in the emerging markets, as well as cater to shift in consumer needs (Ahmed et al 2020).

In addition the approach taken by JIT production technology reduces costs in inventories for the juice and soft drinks manufacturers. Typically, large amounts of finished units in warehouse and tying up capital and storage costs is the case with traditional manufacturing method. By the adoption of JIT production the inventory level which just satisfies the current customer needs will be lessened which frees the capital and decreases storage costs (Kilic & ErKayman, 2021).

Furthermore, all these also help machine produce juice and soft drinks using JIT technology, thus enhancing customer satisfaction. This therefore results in the lowering of lead times and faster performance of the company in delivering the order to customers. In addition to increasing customer trust and loyalty, it helps firms in a complex market to achieve competitive advantage (Kilic and ErKayman, 2021).

The conclusion is that the use of the use of JIT (Just in Time) technology for the production of juice and soft drinks manufacturing companies has a lot of benefits. The acceptance of JIT principles helps companies increase agility in their production, minimize inventory expenditures and provide better service to customers. With the juice and soft drinks market being highly competitive, companies that want to survive these demands have to adopt JIT technology production technology.

Research Problem

Implementation of just-in-time (JIT) production technology in single-digit response time manufacturing companies and customer satisfaction in juice and soft drinks manufacturing companies form an interesting

research problem. The efficiency of JIT production is widely acknowledged in several industries but in question is its implementation and benefits towards the juice and soft drinks sector. Several key questions that need to be answered regarding this research problem are:

- What is the effect of just in time production technology usage on manufacturing firms that make juices and soft drinks, in terms of its effect on rapid response?
- What is the effect of the use of the production technology just in time on achieving customer satisfaction in juice and soft drink manufacturing companies?

These research questions will contribute significantly to the study of how JIT production technology influences customer satisfaction in the juice and soft drinks manufacturing industry. The findings can also provide insights to these sector companies in choosing and deploying JIT practices to optimize operational efficiency and improve customers' satisfaction.

Research objective

- Identify the impact of using just-in-time production technology on manufacturing in rapid response in juice and soft drinks manufacturing companies.
- Determine whether just-in-time production technology can have a direct effect on customer satisfaction in the juice and soft drinks manufacturing industry.

Research Importance

For several reasons, the research on the impact of using just-in-time (JIT) production technology for rapid response in manufacturing and in obtaining customer satisfaction in juice and soft drinks manufacturing companies is of extreme importance:

1. Enhancing customer satisfaction: Customer satisfaction is the key to any business success. The companies need to understand how JIT production technology affects customer satisfaction in the juice and soft drinks industry so that they can choose appropriate strategies that will meet customers' requirements more effectively, reduce lead times and avoid product unavailability, freshness and customization options. Companies are encouraged to introduce JIT practices to deliver customer experience and create relationships of repute with the target market.
2. Unlike other technologies of production, Just in Time production technology focuses on eliminating wastes, minimizing the inventories and improving efficiency of processes respectively. This kind of research will help the juice and soft drinks manufacturers to understand how to streamline their business, how to become more efficient at the storage, and how to become efficient in general. This helps the companies in resource allocation, profit growth and gain competitive benefits in the market.

3. Exceptional Industry Issues: Juice and Soft Drink Manufacturing Industry consists of certain peculiarities and issues. This is why the application and effective utilization of JIT production within this industry could not be the same as in other general industries. The inquiries of the research on this field may be the peculiar constraints and circumstances this sphere encounters like inputs being perishable, demand being very sensitive and seasonal, as well as the challenging quality and inflexible demands. The JIT practices embraced by business must be modified in view of the possible industry specific inhibition of the seamless implementation of JIT.
4. Environmental impact and sustainability: The JIT technology of production can be applied to assist in the sustainable production process and alleviating the environmental impact. This will not only assist the companies to trim the waste down but also to dispose the waste to be and surplus advertising inventory. Since such a study of the impact of the production technology in the juice and soft drink industry can determine how the companies will be capable of adding some form of environment friendliness, by lessening the waste in the packaging, and minimizing the transportation path.
5. Strategic Decision Making: The outcome of the study done regarding the impacts of production technology of the juice and soft drinks industry under the JIT approach can be used in the strategic decision making. This study provides the players in the industry and any other stakeholder with the means to evaluate the advantages and disadvantages of utilizing JIT. This knowledge can be used to make strategic decisions that involve investment in technology, optimization and improvement of processes and supply chains.

In general, the current study focuses on the outcomes of adopting Just in Time (JIT) production technology in terms of production of quick response and enhancement of customer satisfaction in the beverage manufacturing companies (juice and soft drink) with implications to the practicing industry. It offers useful information which assists companies to grow and consolidate their operations and maximize their economic outcomes and stay at the top of their leadership in the dynamic market environment. The firms that will embrace the JIT philosophy will be more efficient, will reduce their costs, and will balance their outputs to suit different consumer demands which will be of primary importance in sustaining profitability in the modern dynamic Marketplace.

Literature Review

➤ Just in Time Production Technology:

Just-in-time (JIT) manufacturing is a manufacturing model where materials or products are made and delivered as near as possible to the time they are required to minimize the inventory and waste levels. This involves repairing processes of production, supply chain and customer demands in a manner that yields the shortest lead time, least cost and finally the optimal efficiency. Lyu, et al (2020) emphasize the waste removal, constant

enhancement and reaction to the requirements of the customer in JIT production technology.

➤ **Rapid Response in Manufacturing:**

Manufacturing with rapid response means that the company can quickly and efficiently respond to customer needs. This means effectively bringing down lead times from the time of order to the time of delivery to make sure the product is ready when the customer needs it. The rapid response includes the timely production process, quickly changing agile supply chain management, and fast order transiting and delivery. The main goal is to facilitate customers' immediate and dependable service to enable the organization to respond to changes in market trends and obtain a competitive edge (Brundel, 2020).

➤ **Customer Satisfaction:**

Customer satisfaction means the extent to which customers are happy and comfortable with the company's product offerings or services. When you hear the term, it means how well a company meets or exceeds customers' expectations and requirements. Factors determining customer satisfaction include product quality, reliability, responsiveness, pricing, after-sales services and total customer satisfaction. It is concluded that being satisfied increases the likelihood that a customer will remain loyal to the company, will recommend the company to others, and also contribute to its long-run success (Otto, et al 2020).

➤ **Relationship between Just-in-Time Production Technology, Rapid Response in Manufacturing, and Customer Satisfaction :**

There is a close and direct correlation between customer satisfaction and just-in-time production technology and rapid response in manufacturing (Ahmed, et al 2020), (Farzanehpour, et al 2023), (Htun, et al 2019).

1. The just in time production technology can enable quick response: the JIT production technology is based upon the minimization of the lead times and optimization of the processes. JIT practices can be applied by the companies that want to reduce the lead times and be able to respond to the order and market demands as soon as possible. The rapid response will be improved in the production whereby the business will be in a position to deliver the orders in less time, delivery in less time and the inventory available will be more.
2. The consumer satisfaction is achieved through quick reaction: The customers are willing to be served as soon as possible and be able to acquire the required products. It is sufficient to conclude that the customer satisfaction is positive when it is possible that the companies could act promptly in response to the orders of customers and deliver to them in the time-sensitive way. This indicates that a business is oriented to the fast turnover to meet the needs of the customer and builds trust, loyalty and customer satisfaction as a whole.
3. The JIT production technologies can be utilized to the customer satisfaction in a favorable manner. JIT causes quality, consistency and reliability of the

products by minimizing excess stock, wastages as well as the burdening of the production and supply chain. These spheres are improved to increase better customer satisfaction. Also, JIT systems can also provide a chance of providing a more personalized approach to firms, a more personalized product line, specific demands among the customers thereby becoming more fulfilling to the clients.

Introducing just-in-time production technology in the production means results in agility in production and rapid responsiveness to customer needs. Conversely, it is positively influencing the customer satisfaction through timely delivery of customer services, reliable supply of products and quality product. These trends of JIT production technology, faster responsiveness in the manufacturing industry and customer satisfaction demonstrate that the significance of efficiency and customer orientation in the manufacturing practices is not only limited to the highly competitive business environment, but it is also significant to the sphere of operations of necessity.

Application framework

Methodology:

The method employed in this study was descriptive and analytical to say that the variables and phenomena that are connected with the research were revealed. It also pays attention to the methods of implementing the statistical methods and implementing it to the study data to provide an application of the results. This approach enables us to get the general picture of the topic matter, and it gives us an insight as it is descriptive as well as quantitatively carried out in order to attain the research objectives.

Study population and sample

The population of the study includes juice and soft drink manufacturing companies. The study uses financial report data from these companies spanning the time from 2010 to 2022 to achieve the objectives of the research. Based on these data the study will carry out the analysis of financial indicators and indicators of operational trends in the industry and will derive the conclusions about the consequences of application of JIT production technology in manufacturing processes and customer satisfaction.

Study tool

The main tool used for collecting data to achieve the objectives of the study was primarily the financial statements and reports published by juice and soft drinks manufacturing companies from 2010 to 2022. The data for the independent and dependent variables came from these reports which made it necessary. The cost of production supplies is represented by the independent variable, Just-In-Time (JIT) production technology. The dependent variables are the time to respond in the manufacturing (production quantities) and customer satisfaction (sales quantities). This data also makes it possible to evaluate the relationship between JIT implementation and its impact on the efficiency of manufacturing and customer satisfaction.

Normal distribution test:

It was ensured that the data that was collected satisfied the conditions for data to be distributed normally by performing normality on the data collected. In particular, the sample Kolmogorov-Smirnov (K-S) test was performed to check whether the data fit in a normal distribution. To check if the data is normally distributed, the significance (Sig) value should be greater than 0.05 and the K-S value must be less than 5 according to the criteria of the test. To check these conditions, data was checked to ensure the normality of the data being studied and thereby ensure the effect of statistical analysis in the study.

Table (1) Testing the normal distribution of data based on (k-s) values

Variables	cost of production supplies	Production quantities	Sales quantities
N	13	13	13
Kolmogorov-Smirnov test	1.337	1.271	1.269
SIG	0.099	0.109	0.112

Source: results of statistical analysis

Based on the results of the test shown in Table (1), the data is found to be normal. The (Sig) values of all study variables were greater than 0.05, and the (K-S) test values of all the variables were less than 5. Therefore, these findings confirm that the data follows a normal distribution and thus meets the necessary conditions for conducting further statistical analysis and the validity of the study's results.

Statistical methods used

The study adopted the Statistical Package for the Social Sciences (SPSS) program to process the data by applying the following statistical methods and indicators:

Descriptive statistics measures: which are mean, standard deviations, the highest value, the lowest value, and shapes and graphs to describe the study variables.

Simple linear regression analysis: to test the impact of the independent variable on the dependent variable and answer Research questions

Descriptive analysis results

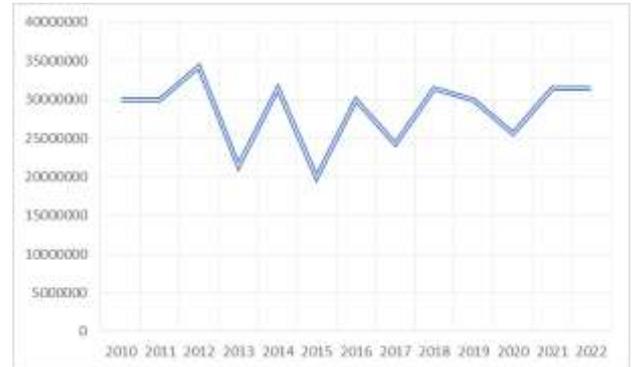
The study variables (cost of production supplies, Production quantities and Sales quantities) about the juice and soft drinks manufacturing companies during the study year (2014 – 2022) were described using descriptive statistics measured in the form of arithmetic mean, standard deviation, highest value, lowest value, shapes and graphs. The results were as follows:

1- cost of production supplies

Table (2) indicates that the mean value of the cost of production supplies in the study period such as 28,531,960 with a standard deviation of 4,319,239.94. In 2012, the highest value was observed at 34,238,52 while the lowest

value was recorded in 2015 at 19,972,372. During the study period (2010–2022) the rate of increase in the runtime of the cost of production supplies was 0.3%. This indicates that the cost of production supplies for juice and soft drinks manufacturing companies started increasing gradually during the study period.

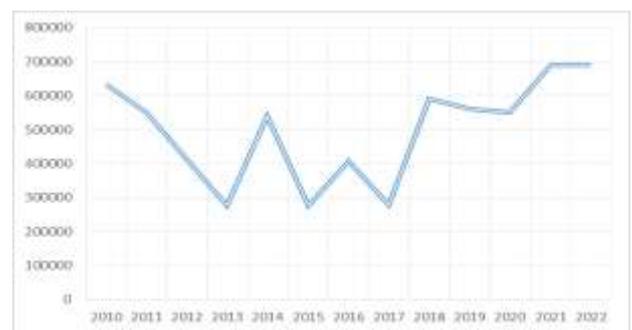
Figure (1) Development of cost of production supplies during the study period (2010-2022)



2- Production quantities

As presented in Table (2), it is evident from the results that the mean values of Production quantities during the study period were 496784.769 with a stand deviation of 151191.577 with a maximum value of 689490 in 2021 and a minimum value of 275784 in 2013. The rate of increase was up to 2.8% during the study period (2010-2022) which shows an increased rate of Production quantities of the juice and soft drinks manufacturing companies during the study period.

Figure (2) Development of Production quantities during the study period (2010-2022)



3- Sales quantities

Table 2 clearly shows the values of the means of Sales quantities during the study period equalled 494341.385 with a standard deviation of 151599.900. The maximum value was 687975 and the minimum was 273190 in 2015. The rate of Sales quantities in the juice and soft drinks manufacturing companies during the study period (2010-2022) increased at a rate of 2.9%, indicating an increase in the rate of increase.

Figure (3) Development of Sales quantities during the study period (2010-2022)

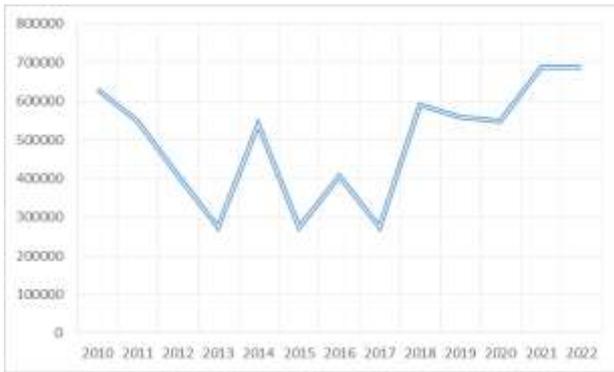


Table (2) Development of study variables during the period (2010– 2022)

Years	cost of production supplies	Production quantities	Sales quantities
2010	29958558	632845	630380
2011	29958558	551568	548780
2012	34238352	413676	409785
2013	21398970	275784	273390
2014	31385156	539460	539088
2015	19972372	275784	273190
2016	29958558	407312	407085
2017	24252166	277892	273190
2018	31385156	591568	589785
2019	29958558	561825	558380
2020	25678764	551568	547785
2021	31385156	689490	687625
2022	31385156	689460	687975

Source: Financial reports of the juice and soft drinks manufacturing during (2011 - 2022)

What is the impact of using just-in-time production technology on rapid response in manufacturing in juice and soft drinks manufacturing companies?

Table (3) Impact of the just-in-time production Technology on Rapid Response

B	T	F	R	P-VALUE
0.025	3.272	10.705	0.702	0.007

It was found that there was a statistically significant positive impact of the just-in-time production technology

on rapid response at 0.05, and it was found that whenever the level of just-in-time production technology increased by 1%, the rapid response increased by 0.025 %

What is the impact of using just-in-time production technology on achieving customer satisfaction in juice and soft drinks manufacturing companies?

Table (4) impact of the just-in-time production technology on achieving customer satisfaction

B	T	F	R	P-VALUE
0.300	2.679	7.175	0.628	0.021

It was found that there was a statistically significant positive impact of the just-in-time production technology on achieving customer satisfaction at 0.05, and it was found that whenever the level of just-in-time production technology increased by 1%, the achieving customer satisfaction increased by 0.300 %

Conclusion

- ✓ The increase rate reached 0.3% during the study period (2010-2022), which shows an increase in the rate of cost of production supplies in the juice and soft drinks manufacturing companies during the study period.
- ✓ The increase rate reached 2.8% during the study period (2010-2022), which shows an increase in the rate of Production quantities in the juice and soft drinks manufacturing companies during the study period.
- ✓ The increase rate reached 2.9% during the study period (2010-2022), which shows an increase in the rate of Sales quantities in the juice and soft drinks manufacturing companies during the study period.
- ✓ There was a statistically significant positive impact of the just-in-time production technology on rapid response at 0.05, and it was found that whenever the level of just-in-time production technology increased by 1%, the rapid response increased by 0.025 %
- ✓ There was a statistically significant positive impact of the just-in-time production technology on achieving customer satisfaction at 0.05, and it was found that whenever the level of just-in-time production technology increased by 1%, the achieving customer satisfaction increased by 0.300 %

Recommendations and Future Research

- ✓ Working to increase companies' awareness of the importance of applying just-in-time production technology
- ✓ Working to increase companies' awareness of how to apply rapid response in manufacturing

- ✓ Working to increase companies' awareness of the need to pay attention to achieving customer satisfaction

Working to encourage researchers to conduct research and studies related to the application of just-in-time

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