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The Relation Between the Technological Change and the Operational Performance from 2011 to 2017: A Case Study in Karwanchi Company for Mineral Waters and Juices

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Abstract
Measuring Performance is one of the important things for managers to know the level of achieving the goals of the organization which contributes to its suitability and existence. Considering this, this paper tries to reveal the appropriate scientific measures to measure the technological changes and operations performance and to show the nature of the relationship between these two things in Karwanchi company for mineral waters and juices. To answer the questions, a set of hypotheses were set in relation to the different variables. The data were collected from the company's records of the studied variables. The researchers then used mathematical equations to measure the technological change and the operations performance in the studied company. Moreover, they also used SPSS V.24 to measure the nature of the correlation of the variables. This study concluded that there is a negative and positive correlation between technological changes and operations performance for all dimensions which contributed to supporting the operations performance in the studied organization whether it was inverse or direct correlation. One of the most important recommendations presented here is that the company needs to decrease the time of the production cycle and to better use the production elements and also to better utilize the machinery and equipment within the time limit for the productivity in order to improve production operations.

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1 Introduction:

Today's world is characterized by rapid change and growth with increasing levels in a way that has not been witnessed in history. This change has been associated with an ongoing change where it became an existential must that cannot be ignored. Companies thus have started to spend huge amounts of money to use new technologies and to train their staff in order to increase productivity and to achieve higher levels of professional, environmental, and educational levels to their staffs to reach desired economic and social integration. Such an integration will improve operations performance of companies. Having said so, this study tries to explore the relationship between technological changes and operations performance in Karwanchi company for mineral waters and juices. The focus of this study is on the

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following: 1) research methodology, 2) theoretical framework, 3) analytical framework, 4) conclusions and recommendations.

2 Theoretical Framework

2.1: The concept of technological change

The development that the world has witnessed since the eighteenth century in the dawn of the first and second industrial revolutions and the appearance of technological changes such as the use of steam engines in factories to replace workforce and then the appearance of electrical power to replace the steam power all has associated with huge impact on the productivity for centuries. The appearance of new forms of technology that companies can use leads to higher levels of productivity but at the same time companies could race into gaining other newer technologies even though they already have rapid production technologies (Dilme 2008). In fact, any discussion of the meaning of technology and technological change must consider the fact that some technology components are more valuable than others. That is, the more valuable technological components replace the less valuable ones; for example, replacing horseless carts is more valuable. The discovery of electricity led to replacing steam power because the former one is more valuable (Crabtree 2006). In the twentieth century, the concept of technology has been associated with two phrases for researchers and scientists: *technological changes and technological innovation*. Technological change is a modern and accurate term, but what does that term mean? To answer this, (Daft 2001) defines it as "the changes in production operations of organizations based on skills and knowledge that increase abilities." (Robbins 2001) has defined it as "the changes in technologies associated with equipment, machines, automations and computerization."(Al Fatlawee 2005) defines it as the re-organization of designing. (Godin 2015) has defined it as the development of better ways of doing something or discovering how to do something that was impossible to be done. Thus, it refers to finding new ways of production and designing new products and services.

2.2 The significance of technological change: the significance of technological changes can be summarized in the following:

A- Technological change helps to create innovations and find better methods to do things which leads to improvement and development (Al Zaydee 2009).

B- technological change helps to change the demand framework toward up-to-date and skilled workforce and to utilize opportunities and cope with environmental threats and avoid routines (Al Fatlawee 2005).

C-Technological change is considered one of the reliable measures in the world that are used to measure the improvement levels in livelihood levels for humans where around 60% to 80% of these levels are attributed to technological changes (Amar and Sada, 2004).

D- Technological change is considered an important means for improving production in terms of quantity and quality and also to keep intact the competitiveness of the organization and to improve it to increase workers' motivation (Pettinger and Frith 2000).

2.3. The elements of successful technological change: There are several elements for successful technological change including:

A- Support of the administrative leadership: Changing and developing the organization should receive the support and encouragement of the administrative leadership in that organization because the number of challenges and surprises in the competitive and technological environment requires more efforts to cope with and adapt to as fast as possible (Kouzes and Posner 1988).

B- Having interpersonal skills (persuasive skills): Change is a hard process because the human nature likes routine and one-way work but

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change leaders feel the needs and tendencies of their workers and employees and feel their feelings through their leaders' emotional intelligence which enables those leaders to see through the employees' potentials and the change that can be done in democratic and empowering terms (Reason 1998).

C- Identifying resources of satisfaction and teamworking spirit: Confidence is considered one of the satisfaction resources where it leads to energizing and more faith in the organization and thus a loyalty and affiliation and teamworking spirit which is achievable only through transparency and fearlessness in discussion and encouraging participation in the decision making process especially the ones that relate to the changes that touch upon the very existence and sustainability of the organization in the market and to achieve the planned-to profits (David Sirota et al. 2005)

D- Providing information and paying attention to reverse feedback: Providing information and its flow and circulation is one of the factors for the technological change to succeed and in order to know the employees' reactions and also to study these reactions and to find solutions for the emerging problems in a transparent way; this tendency is confirmed in the research literature of communication such as transparent and overt management (Open book mgt; Lioyd and Case, 1998).

2.4. Measures of technological change: Technological change is measured through the analysis of factors and indicators related to the main objectives and goals of the organization which include the following equations (Al Zaydee 2009):

$$\textit{The average of the daily production} = \frac{\textit{the amount of real produced}}{\textit{the number of production days per year}} \quad (1)$$

$$\textit{The time of the production cycle} = \frac{\textit{dailly production time}}{\textit{daily prodcution average}} \quad (2)$$

$$\textit{Efficiency of the production system} = \frac{\textit{real production}}{\textit{effective productivity}} \quad (3)$$

$$\textit{The mean of time between mechanical problems} = \frac{\textit{the number of real production hours}}{\textit{number of mechnical problems}} \quad (4)$$

2.5 Operations performance

1.The concept of operations performance and its significance: To compete with others in the world markets, companies should try to achieve very good performance. Evaluating good performance has an important role in helping companies succeed. Having said so, performance measurement has received a huge attention because of its impact on performance itself. That is, the lack of clear and appropriate performance measures will lead to an inability to meet the customers' needs which negatively affect the company's competitiveness. Measuring performance provides competitive merits for the company through helping to correct its problems and faults. Measuring performance has an important impact on the cost and reliability of the product as well as the production cycle, etc. Thus, measuring operations performance remains an important topic in recent studies (Hwang 2014). There are several concepts lie under the concept of performance, some of them relate to failure, success, efficiency, and effectiveness. Thus, studying performance encounters many challenges represented in the concept and its measurement indicators leading to a difference between people who are interested in performance as well as the interests of researchers have varied where some of them focused on profit, sustainability, and growth which are by far financial indictors that do not provide by themselves accuracy in measuring performance

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because they are not predictive and focus on short-term goals while the more comprehensive concept of performance is the one that focuses on such aspects as market shares, quality of product, efficiency of marketing, effectiveness of technology and its ongoing changes (Ali 2005). (Al Jabori 2002) defines is as the organization's ability to achieve its goals through using the available resources in an efficient and effective way. (Lazim 2007) refers to the concept of performance as a reflection of how to use the organization's financial and human resources and utilizing them in a way that makes the organization able to achieve its desired goals through the five performance goals: quality, cost, flexibility, reliability, and speed. The reasons behind the increasing interest in studying and measuring operations performance is the following (Al Kayalee 2001):

A-The changing nature of work and the increasing competition.

B-The national and international prizes.

C-The change in the organizational roles and the outside demands.

D-Innovation and ongoing improvement.

E-The power of information technology.

To show the significance of the operational performance,(Michael 2007) points out that unifying the operational dimensions results in benefits for organizations in rationalization and growth of businesses and operations where the dimensions of operational performance is the common language in an attempt to put forward concepts of discussing operational performance and comparing it among the units and departments inside the organization. Thus, researchers consider operational performance as a set of internal activities of the organization that it tries to achieve to provide services and products that meet the customers' needs and benefit the organization.

2.The typical indicators for measuring operations performance (operational performance): Measures are considered an important resource to measure performance. That is, if the measure is mistaken or wrong, or set up wrongly, it will negatively impact performance. Thus, it is important to set forward the right measures of performance to evaluate the likelihood of success in achieving the organization goals, to provide the right consultation and corrective recommendations for the company, to evaluate the outputs and inputs inside the company (Hwang 2014). Henceforth, there are several indicators and pointers used in measuring operations performance according to the following equations (Al Lamee 2007)

$$Product\ quality = \frac{number\ of\ flawed\ units}{total\ number\ of\ produced\ units} x100 \quad (5)$$

$$The\ mean\ of\ outside\ customer's\ satisfaction = \frac{number\ of\ warranty\ complaints}{number\ of\ sold\ units} \quad (6)$$

$$Production\ hours\ of\ real\ operations = \frac{number\ of\ produced\ units}{number\ of\ machines' operation\ hours} \quad (7)$$

3 The methodology of the study

3.1.The study problem: The focus on the different production operations, the increase of the production efficiency, the decrease of decay and wastage and excessive production, and the best use of productivity, the providing the customers' needs, all of these aspects require a change in the infrastructure to bridge the gap between operations performance in Iraq and those in the developed countries in light of the ongoing technological development leading to the need to develop and change the technology used in production operations that can contribute to the improvement of operations performance that help qualify the studied company to cope with the global markets. Thus, the problem of this study can be summarized in the following questions:

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A-Is it possible to measure the technological change and operations performance in the studied company?
B-To what extent is technology used in the studied company?
C-What is the level of operations performance in the studied company?
D-What is the relationship between the technological change and operations performance in the studied company?

3.2.The significance of the study: The significance of this study can be attributed to the goals it aims to achieve and as follows:
A-Identifying the specific measures in relation to technological change and operations performance.
B-Analyzing the process of technological change that takes place in the studied company.
C-Identifying the level of operations performance in the studied company.
D-Identifying the nature of the relationship between the technological change and operations performance.

3.3.The hypothesis of the study: There is a correlation of statistical significance between the technological change and the operations performance in the studied company.

3.4.The scope of the study: This study falls within the following limits:
A- Place limits: This study was conducted in Karwanchi company for mineral waters and juices in Kirkuk.
B-Time limits: This study was conducted in the second half of 2018.
C- Research limits: This study only focused on the analysis of two variables: technological change and operations performance in the records of the studied company.

3.5.Data collection methods and data analysis: In order to make it clear to the reader in relation to the theoretical and analytical sides of the study, the researchers used the following resources:
A- The literature and research done in relation to the studied topic including the internet.
B- Surveying the quantitative data in the records of the studied company.

Having said so, the researchers used mathematical equations and statistical testing to analyze the collected data. SPSS v. 24 was mainly used to analyze the data and test the study hypothesis.

3.6. Description of the study population: "Karwanchi company for mineral waters and juices was launched in 2010 after the success of (Al Tameem, and Al Muna), Karwanchi company has been opened where it is considered one of the biggest companies in the country in terms of buildings, size (40 acres) and its production lines and productivity and thus, it is the first and biggest light juices company where it includes three production lines with a production of 28000 cans per hour and production was as follows" (Khazal 2018):
1-producing all sizes of plastic cans (1 liter and 2 liters) of juice products and for all colors.
2-producing all sizes of plastic cans that contain sparkling drinks.
3-producing plastic cans that contain pure water of (0.5 liter) a can.
"In 2011, three more lines of production were added to produce small cans of water with 250 ml and with a production of 6000 cans per hour for each line, and to reach the best level of product quality, the company thus launched a new laboratory and quality control to periodically check all components used in the products".

4 The practical side

In order to know about the application of the technological change and the levels of operations performance in the studied company and also to know about the acceptance of the study hypothesis, the researchers depended on a number of mathematical equations as follows:

4.1. The technological change

1.Time of the production cycle: The time of the production cycle can be calculated according to the following equations:

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The daily production time=7 hours of production per day, with 3 production shifts per day which means 3x7=21 hours

$$\textit{The average of the daily production} = \frac{\textit{the amount of real produced}}{\textit{the number of production days per year}}$$

$$\textit{Time of the production cycle} = \frac{\textit{production time available per day}}{\textit{average of daily production}}$$

The findings of table 1 show stability in the time of the production cycle for most years, and they show relative instability for 2014 for sparkling water, and relative instability for 2014 and 2015 for juices. This instability is attributed to the political and security circumstances that led to instability of production within the cycle. The longest production cycle for sparkling water was in 2014 which reached (1.34 h/d) while the shortest time for the production cycle was in 2012 reaching (0.24 h/d). The longest production cycle for juices was in 2015 reaching (1.85 h/d) while the shortest production cycle for juices was in 2011 reaching (0.18 h/d).

Table 1. The time of the production cycle of Karwanchi company 2011-2017

Years	Production time available per day	Amount of production		Number of work days per year	Average of daily production		Time of the production cycle	
		Mineral waters	Juices		Mineral waters	Juices	Mineral waters	Juices
2011	21	20000	31000	295	67.79	105.08	0.3	0.18
2012	21	25000	22000	295	84.74	74.57	0.24	0.28
2013	21	22700	23000	295	76.94	77.96	0.27	0.26
2014	21	4600	4000	295	15.59	13.55	1.34	1.54
2015	21	7000	3350	295	23.72	11.35	0.88	1.85
2016	21	8000	8000	295	27.11	27.11	0.77	0.77
2017	21	8200	8000	295	27.79	27.11	0.75	0.77

Resource. This table was prepared by the researchers based on the company's records.

2.The efficiency of the production system: It is calculated using the following equations:

$$\textit{Efficient (active) productivity} = \frac{\textit{expected productivity (planned one)}}{\textit{design productivity}} x100$$

$$\textit{Efficiency of the system productivity} = \frac{\textit{real production}}{\textit{active productivity}}$$

The findings in table (2) show an increase in the efficiency of the production system in 2011 with (106.25) and this increase is attributed to the increase in production reaching (60000). This amount of production is the highest amount of production in the studied company when compared to other production years. The efficiency of the production system decreased in 2014 to reach (43.00) because of the decrease in the production (8600) due to the security circumstances that the country witnessed during that time where raw materials were not delivered on time.

Table 2. the efficiency of the production system of Karwanchi company 2011-2017

Years	The amount of the real production of mineral waters and juices	The expected (planned to) productivity	Design productivity	Real productivity	The efficiency of the production system

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2011	51000	60000	125000	0.48	106.25
2012	47000	57000	125000	0.45	104.44
2013	45700	51200	75000	0.68	67.2
2014	8600	15000	75000	0.2	43
2015	10350	12000	75000	0.16	64.68
2016	16000	12000	75000	0.16	100
2017	16200	12000	75000	0.16	101.25

Resource: This table was prepared by the researchers based on the company's records.

3.The rate of benefit: It refers to the rate of benefit of the available productivity and it can be calculated using the following equations:

$$\textit{The rate of benefit of the available productivity} = \frac{real\ production}{availble\ productivity} \text{x } 100$$

The findings of table (3) show that the highest level of production benefit rate was in 2011 reaching (68%) of the studied company. There is also a fluctuation in the amount of production which decreased hugely in 2014 because of the country circumstances that affected the benefit rate to reach (11%) because of shortage of the raw materials for the studied company.

Meanwhile, production increased noticeably in 2015, 2016, and 2017 consecutively to reach (10.350), (16000), and (16200) due to the renewal of machinery, equipment, and the technological update to this machinery:

Table 3. The rate of benefit obtained from the available productivity between 2011-2017

Years	The amount of the real production of mineral waters and juices	The available productivity of Karwanchi company	The rate of benefit from the available productivity
2011	51000	75000	68%
2012	47000	75000	62%
2013	45700	75000	60%
2014	8600	75000	11%
2015	10350	75000	13%
2016	16000	75000	21%
2017	16200	75000	22%

Resource: This table was prepared by the researchers based on the company's records.

4. The mean of time between the stops of mechanical problems: It is calculated using the following equations:

$$\textit{The mean of time between the stops} = \frac{real\ hours\ of\ operation}{number\ of\ stops}$$

The findings of table (4) show that the mean of time between the stops in 2014 was (31.36) in comparison to the real hours of operation (6195) in relation to the highest number of stops (195). The stability of real operation hours with the increase of stops indicates that the studied company handle the operational failure in machinery an equipment due to handling of the highest level of stops in 2017 (476.53) due to the low number of stops (13) which indicates a weakness in machinery maintenance of the machines used in the production process in what impact the efficiency of production.

Table 4. the mean of time stops for Karwanchi company between 2011-2017

Years	Real operation hours	Number of stops	The time mean between the stops
2011	6195	88	70.39

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2012	6195	98	64.21
2013	6195	122	50.77
2014	6195	195	31.76
2015	6195	28	221.25
2016	6195	14	442.5
2017	6195	13	476.53

Resource: This table was prepared by the researchers based on the company's records.

4.2.Operations performance

1.The product quality: it can be calculated using the following equations

$$The\ product\ quality = \frac{the\ amount\ of\ flawed\ units}{total\ number\ produced\ units} x100$$

The findings of table (5) show that the highest rate of product quality was in 2014 (4.58%) for mineral waters while the highest rate of product quality for juices was in 2015 reaching (3.64%). At the same time, we note that the lowest rate of product quality for the studied company for both mineral waters and juices was in 2017 (0.14%), (0.13%) consecutively. This decease of product quality was due to decrease in the produced amount and the increase in the number of the flawed units. The results indicate a decrease in the product quality because of the old machines and cut-off of electricity and the weakness in machines maintenance.

Table 5. The product quality in Karwanchi company between 2011-2017

Years	The amount of real production		The number of flawed units		The product quality	
	Mineral waters	Juices	Mineral waters	Juices	Mineral waters	Juices
2011	20000	31000	450	650	2.25%	2.09%
2012	25000	22000	620	455	2.48%	2.06%
2013	22700	23000	825	570	3.63%	2.47%
2014	4600	4000	211	133	4.58%	3.32%
2015	7000	3350	87	122	1.24%	3.64%
2016	8000	8000	15	17	0.18%	0.21%
2017	8200	8000	12	11	0.14%	0.13%

Resource. This table was prepared by the researchers based on the company's records.

2.The average of customer satisfaction: It is calculated using the following equation:

$$The\ average\ of\ customer\ satisfaction = \frac{the\ number\ of\ warranty\ complaints}{total\ number\ of\ sold\ units} x100$$

The findings in table (6) show that the highest level of customer satisfaction of mineral waters was in 2016 (3%) and this percentage indicates that customer satisfaction increase is in parallel with the increase in the number of warranty complaints which led to the improvement of the product quality and thus an increase in the number of the sold amounts. The highest rate of customer satisfaction was in 2015 (2%) for the juices in the studied company.

Table 6. the average of outside customer satisfaction for Karwanchi company between 2011-2017

Years	The amount of real production		The number of flawed units		The product quality	
	Mineral waters	Juices	Mineral waters	Juices	Mineral waters	Juices
2011	20000	31000	450	650	2.25%	2.09%
2012	25000	22000	620	455	2.48%	2.06%

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2013	22700	23000	825	570	3.63%	2.47%
2014	4600	4000	211	133	4.58%	3.32%
2015	7000	3350	87	122	1.24%	3.64%
2016	8000	8000	15	17	0.18%	0.21%
2017	8200	8000	12	11	0.14%	0.13%

Resource: This table was prepared by the researchers based on the company's records.

3.The productivity of real operation hours: It is calculated using the following equation:

$$\textit{The productivity of real operations hours} = \frac{\textit{the number of produced units}}{\textit{the number of machines operation hours}}$$

The findings in table (7) show that the highest rate of real operation hours for the mineral waters was in 2012 (4.03%) while the highest rate of real operation hours of juices was in 2011 (5.004%). The increase in the operation hours is attributed to the increase in products demand during these years which resulted in an increase in the number of the produced units.

Table 7. the productivity of real operation hours for Karwanchi company between 2011-2017

Years	The number of sold units		The number of warranty complaints		The average of customer satisfaction	
	Mineral waters	Juices	Mineral waters	Juices	Mineral waters	Juices
2011	18000	29000	210	127	0.011	0.004
2012	22000	21000	59	190	0.002	0.009
2013	19500	21700	88	129	0.004	0.005
2014	3750	3800	25	29	0.006	0.007
2015	6011	3010	91	80	0.01	0.02
2016	7000	7023	250	95	0.03	0.01
2017	8000	7025	100	45	0.01	0.006

Resource: This table was created by the researchers based on the data of the company's records.

4.3.The analysis of the correlation between the technological change and operations performance

Table 8 shows the findings of the analysis of the correlation between the independent variable represented by the technological change with all its dimensions (the time of the production cycle, the efficiency of the production system, the benefit from productivity, and the mean of time between the stops) and the dependent variable represented by (product quality, the average of customer satisfaction, the productivity of real operation hours). These findings, with the whole indicator, show a positive statistically significant correlation between the technological change (independent variable) and the operations performance on the overall level with a correlation coefficient (0.899) with a significance value of 0.05.

Table 8. the correlation between the technological change and operations performance on all dimensions.

The independent variable / The used dimension	The time of the production	The efficiency of the production system	Benefit from productivity	The mean of time between stops	The whole indictor
The product quality	0.466*	0.741*	0.449*	0.915-*	0.125*

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Customer satisfaction average	0.413*	0.535*	0.548*	-0.652*	0.510*
The productivity of operation hours	0.915-*	0.468*	0.861*	0.524-*	0.430*
The whole indicator					0.899*

P*≤0.05

These findings reveal a significant correlation (both positive and negative) between the different dimensions of the variables used in this study. They show that the highest correlation (a negative one) was between the product quality and the time between stops. That is, whenever time between stops decreases for reasons of machines maintenance, the quality of the product increases. These findings lead to accept the study hypothesis that there is a significant correlation between the technological change and the operations performance in the studied company.

5.Conclusions and recommendations

5.1.Conclusions:

1. The findings show instability in the production cycle time in the studied company in some years which can be attributed to that this company has problems in the instability in the production lines due to its inability to lessen the time of the production cycle which resulted in the appearance of wasted time in the production cycles. Part of these problems is also related to the security circumstances that prevented stability.
2. The findings show that there is an increase in the efficiency of the production system for most years. That is, there is an adaptation and correction for the flaws and corrections for the standard levels that relate to the material elements that contribute to the production process which resulted in an increase in the productivity and a decrease in the total costs for each unit.
3. There is a benefit from the productivity in the studied company for most years which can be attributed to utilizing the material resources that are used in the industrial operations as best as possible in a way that impacted the real production.
4. The mean of time between the stops was acceptable. This mean refers to a prediction of the mechanical problems which contributed to the improvement of maintenance of machines and equipment in the studied company that helped handle operational malfunctioning.
5. There is a decline in the product quality for mineral waters and juices for most years due to an increase in the flawed units in relation to the produced units because of the old machines and equipment and the cut-off of electricity which led to having more flawed units.
6. Customer satisfaction of the company's products was in decline for most years covered in this study which was noted through the increase of customers' complaints about the flawed units.
7. There is a good rate of the real production hours for most years covered in this study which determines the capacity and ability of the machines to produce a specific number of units per hour to meet the demand on the company's products.
8. There is a positive and negative correlation between the technological change and the operations performance for each of the different dimensions to support the operations performance variable in the studied company whether being a direct or inverse relationship.

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5.2.Recommendations

1. The company needs to decrease the time of the production cycle that the product takes in the different production departments through making changes in the production equipment and machines as well as to set up an accurate planning for production through specific time intervals.
2. There must be a better use of the production elements in the company to achieve the highest level of production and productivity within the specific levels and with lowest costs and the need to appoint specialists and experts to monitor the procedures to improve the efficiency of the production system.
3. There is a need to train employees to increase the efficiency of production to lessen the standard time to produce each unit. Moreover, there must be a more benefit from the available productivity through the best use of machines and equipment within the time limit available to productivity that contributed to encounter the ups and downs of demands on the company's products.
4. There must be a periodical maintenance for machines and equipment to insure the continuity with the lowest number of stops as well as working on fixing mechanical problems as fast as possible to improve the efficiency of production.
5. There is a need to make sure that the raw materials used in the production meet the required standards. Moreover, there must be a compliance with the specific standards of quality in all the production activities in the company to achieve the highest required level of quality as well as adopting a culture of ongoing improvement for quality in the different departments in the company.
6. There is a need to reconsider customer satisfaction as a justification for the existence of the company so that the customer's needs and tendencies are met. Consequently, meeting these needs and tendencies will lead to an increase in the company profits.
7. There is a need to scheduling employees and workers as well as organizing their work hours to make a better use out of the available hours and to lessen the wasted work hours.

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