

Technology Influence on Product Quality, Speed of Delivery and Cost

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Abstract

This paper explores the hypothesis that technology can be used to improve product quality, speed up delivery and reduced cost. For companies improving the quality of their products, reducing the cost and improving the speed of delivery makes them favorable to the client who feels like all their needs have been met. The research occurs between the months of January 2018 to April 2018 which is about four months. The research experiment design uses the pretest-posttest experimental design set up between two companies both using the traditional method of manufacturing with no technology. In one company technology is introduced while in the other company the process remains the same traditional method of production. Both companies analyze the results at the end of a four-month period before a conclusion is drawn from both the pretest and the final test. The experiment results show that technology improves quality of the product, improves the speed of delivery while at the same time reduce cost benefiting both the producer and the client. Technology should, therefore, be implemented in companies to give them an edge over the competition. With technology in companies, the United States can reclaim production from overseas companies that have taken over by providing cheap labor. Better satisfied customers mean more production which in turn means more jobs for the people in the United States.

Keywords: Technology, Quality of Product, Speed of Delivery, Cost, Pretest-Posttest Experimental Design.

Introduction

These three factors, product quality, speedy product delivery and low cost define most company's success because those are the three most important factors in a buyers mind when they are selecting a supplier. Each of this factors on their cover a wide range that can divide into many sections and parts. Quality can mean how reliable, durable is the product? How are the finish and design? To improve quality, the suppliers must define quality from the perspective of the client. Using the customer's point of view on what is better for them helps suppliers meet those objectives at a minimum cost [1]. Quality can also be achieved by solving a problem entirely; achieving quality is by looking at the root problem and fixing it not just patching up what is on the surface. The commitment to quality of a company comes from the very top of the organization, and it has to be reinforced at all times. If the business does not view quality as the main goal, then the employees will feel the need to make some compromises and the quality will drop [2].

While the price may include the market price, discounts offered, the credit and allowances available. The manufactures or producers have to give a low cost while still meeting the bottom line for them to survive in a competitive market. To do this, they have substituted materials for those of a lower cost with the same function,

eliminating unnecessary product features and buying what they need not what they will need in future. The trick with this is finding the right balance without compromising the quality of product while having a low price of production and distribution [3].

Speedy product delivery simply means how fast your product gets into the market and how fast it is consumed by the consumers. To improve speedy delivery, the producers can simplify their internal processes, not use complex processes for one task will aid in a fast, quick and simple delivery to the consumer. Another way has very clear communications with the warehouse holding the products, so their products are not locked down while they wait for it. Another method for speedy product delivery is to have a list of courier services and choosing the best but always have a backup [4].

Between 1990 and 2001, many American companies were shifting over their production to countries like China because those companies were offering to make the same products for about 100% per unit less than the cost of production of the same product in the USA [5]. They had to move the company production overseas to stay competitive in the current market. The move wiped out many job opportunities in the states, but now those companies are shifting back to the United States. These are because over the last few years the Chinese labor and the transportation costs have increased while the one in the U.S. has remained the same [6]. The increase in the Chinese currency has led to an increase in base wage, measured

by U.S dollars to rise to up to 17% a year. Another problem that is facing goods and products being outsourced from China is the quality of the product produced by them has gone down, so they all have to be double checked before using [7]. The prices of production are escalating, quality of the finished product is dropping, and the deliveries are being delayed [8].

In the meantime in Pakistan is now becoming a prime spot for outsourcing any production with information technology. Pakistan is being considered because of the favorable economic circumstances brought about by the new tax laws introduced in India. The few reasons why Pakistan is now a hot spot for outsourced IT products is because there is a higher labor availability because they have fewer holidays as compared to India [7]. More executives with western experience in the firms, fewer accents, professionalism, and integrity of the employees, good accents, so communication is easier, and the low-cost talent pool; are some of the other things that make Pakistan a hotspot. All this ensures that the products produced will be of high quality because of the talent, ensure speedy delivery because of better communication and the cost will also be favorable because they pay will not be too high eating into the profit [6].

With companies and manufactures shifting back to the U.S they will need a way to improve product quality, speed up their delivery and reduce the cost of their products for them to have an economic edge [9]. To also fight against upcoming Pakistan in the tech industry they need to do better with the quality of the product, their speed of delivery and cost of the product. Innovation has been perceived as one of the focal drivers of development, and one of the growing sectors of innovation is technology. Technology has brought about change with the innovations of better, cheaper materials, faster machines that can do the work of about four people and improved the communication line between the supplier and customer, therefore, improving the speed of delivery. The research aimed at finding out if technology had improved quality of the product, reduced the cost of production and improved speedy delivery [10].

How Technology has Improved Product Quality, Speed up Delivery and Reduced Cost

Technology is the understanding and know-how of using the correct tools and machines that can do tasks more effectively and efficiently. Technology is used to control the world we live in including production [11]. Advancements in technology where production is concerned to make the production process very easy, simple and reduce the manufacturing cost. As technology advances then the number of units produced will increase which causes a decrease in the average variable cost that is the cost that varies with the number of units produced [12]. The increase in production causes a spread of the fixed cost over more units. Therefore, the average fixed cost decreases too. The decrease in average variable cost reflects the advancement of technology like machinery, computer technology, and since machines are replacing labor or jobs, there is a decreasing variable cost [13]. For example, the Toyota auto motives were constructed with skilled workers about twenty years ago, but now they can be built with robotics [14].

A company in China the Changying Precision Technology Company, located in the Dongguan city has established a factory that is operated by 90% robots receiving fewer defects and higher production rate. The robots produce about three times as many products as those produced before, a person's production increased from 8000 units

to 21000 units which are about a 162.5% increase. The high quality of the units has also increased the rate of product defect going from about 25% to about 5%. As per the International Federation of Robotics study, the production of electronics has had the biggest growth concerning industrial robots with China being the largest market for industrial robots with about 60000 robots being sold [15].

The leading example of the use of technology for speed up delivery is the restaurant business that uses smartphones and social media. New research by the Technomic on consumer-facing technology displayed that customers envision a world where the new technology combines with their dining involvement. They have set this fast delivery by mobile ordering, iPad order kiosks [3].

The Order and Delivery Process goes like this; the customer places an order, deliverer is selected, the product picked from the merchants, product delivered to the customer and customer receives the product [16].

U.S industrial has been through many tough times in the past few years with employment rate dropping from 14% to about 8% of the workforce. Those jobs were shifted to the overseas as the owners sought after low-cost labor and the nations that had very few safety and environment regulations. Due to technology in automation, robotics, and advanced manufacturing, the employment has increased to about 12.3 million in 2016 which is still lower than 2006 14.5 Million, but it is better than the Great Recession. Some of the restaurants are deploying robots to transport the foods and organizing kiosks for self-ordering by clients. Driverless cars have sprouted in California, Texas and some parts of Washington. Amazon now has about 15000 robots who labor alongside about 50000 human beings [17].

In the world the number of robots in the industry is also rising, in 2013 there were almost 1.2 million of the robots in workshops and warehouses, and those numbers saw a rise to 1.5 million in the year 2014 and will rise again to about 1.9 million this year. The number of robots in North America alone is almost 237,000 [18].

In line with this argument provided the purpose of this research is to weigh the success levels that technology can have in improving product quality, reducing costs and increasing speed delivery in production companies. The study aims to compare two production companies by their method of production in the technologically advanced or the traditional companies. The other aim is to assess the effectiveness of technology in the companies regarding product quality, the speed of delivery and cost of production [19].

The traditional methods of production before the introduction of technology needed more people and more materials to produce the same product which made it very expensive for the client as the companies tried to meet the bottom line. Humans are prone to error, so there was a lot of wasted resources also increasing the cost of production [20]. The number of people and man hours needed to produce goods were high, and they needed salaries, health covers and personal covers as stipulated by the unions [21]. The money ate into the company's bottom line making many companies shut down because they could not pay their bills anymore. Humans could also get sick calling do a day off leading to low manpower in production or get injured and loss their limbs in the whole production process [22].

The research question to be answered by this study is as follows: To divulge whether there is a noteworthy alteration in an increase of quality of products, the speed of delivery and low cost using technology.

The working conditions in a technologically based company.

Research Design

Research Methodology

Throughout the study, brainstorming recognized as a product-centered method with question answer techniques, surveys and result oriented analysis [23]. The research tries to determine the improvement of quality, speed up delivery and reduce cost through the use of technology in the production process.

In the study held in the technology-based production setting, the independent variable is the increase in quality, decrease in cost and speed up delivery in the traditional company, Blenders Company, and the dependent variable is the Strip Production where technological

production will be applied. The research has therefore been conducted on a pretest-posttest experimental model, and it has used this model to try to figure out the extent to which the independent variable impacts the dependent variable. For the achievement of this results, a test group and control group have formed by the researcher to help make this experimental model a reality. The groups formed are [24].

The control group: The Blenders Company that uses traditional methods of production.

The test group: The Strip Production where technological production method is will be applied.

Tests used as the pretest before any changes were made and the final test as the posttest were both applied to both groups when the research starts and at the end of the experimental period, this is used to evaluate the product quality, cost of production and speed of delivery. The pattern for this research model with both the pretest and posttest of the control groups looked as follows:

Table 1: Pretest Posttest of Control Group

Groups	Pretest		Posttest
Traditional production method	The records of the product quality, cost of production and speed of delivery for the traditional based production	Application	The final records of the product quality, cost of production and speed of delivery for the traditional based production
The technologically based production method	The records of the product quality, cost of production and speed of delivery for the technologically based production	Application	The final records of the product quality, cost of production and speed of delivery for the traditional based production.

Participants

The research has been done based on two companies in the same geographical area in Michigan both producing blenders. The research was between January 2018 and April 2018. The two companies involved had about a hundred employees each. To minimize the bias and address all the issues with conflict of interest the experiment was also done in other parts of the country with one done between two companies in South America and two done between companies in the Midwest. The questions asked were also formulated by the lead researcher and colleagues based in companies and review boards [25].

The owners of the companies decided to participate in the study since the results would benefit them in making their companies better. In the beginning, the workers who were willing sat through a question and answered session and completed a survey based on their working conditions. In the end, the same workers sat through another question and answered session and a survey.

In the two groups the quality of the products, the speed of delivery and cost of production in the pretest are compared. The values considered acceptable to form the test and control group are gained from this comparison. Use of Cluster Analysis Technique formed the data, and they were analyzed by the program for statistics SPSS 16.0 for Windows.

The pretest values gave been analyzed for the November month period, and the data that was acquired is as follows:

Table 2: Acquired Data for Pretest Values for the Month of November

GROUPS	%QUALITY	%SPEEDY DELIVERY	% COST IN DOLLARS
TEST	54	67	1000
CONTROL	55	68	980

The pretest values gave been analyzed for the December month period, and the data that was acquired is as follows:

Table 3: Acquired Data for Pretest Values for the Month of December

GROUPS	%QUALITY	%SPEEDY DELIVERY	% COST IN DOLLARS
TEST	56	68	1000
CONTROL	58	66	980

The overall quality of products, speed of delivery, and cost of the product in dollars of December and November of both the test group and the control group have been equated by using independent sample test, and the information analyzed and developed is in the table shown above. If we follow the table above and its findings we can say that the groups were assigned objectively in the groups with their merit. The table also displays that their no substantial difference between the two groups when they are both using the traditional method.

The questions in the survey included the gender, years they have worked in the company and what they prefer about the company. In the question and answers section, the questions included:
Is your environment safe to work in?
How many hours do you work in a day?
What is the salary if compared to tasks performed?
Days they have called in sick
The number of times they had to throw away a product and start a new when they spoiled the one they were working on?

This questions helped determine the overhead cost of human productivity to how it will affect the cost of the final product.

Data Collection and Analysis

Through evaluation of all the data acquired and the view of opinion from the experts, theoretical dimensions have been created. The test data has been collected using the tests and analysis done on product quality, the speed of delivery and reduction of the cost [5]. These analysis tests are done before and after the application of the program. After the control and test groups formed, the traditional method of production and product delivery was done on the control group, and technological based method of production and product delivery was done on the test group. To improve the testing tools in the study and to help in the assessment of the information that was acquired as a result of the study, many analysis functions have been used.

Throughout the data evaluation methods like item difficulty index, KR20 reliability coefficient, item discrimination index and percentage and frequency have been used. The Reliability interval for this statistical evaluation and operation was taken to be $0 < 0.005$, and in to analyze the right pack program SPSS 16.0 for the Windows has been deployed [8].

The Data Collection Tools

The data collected using the data collection tools that have been deployed to be able to regulate the product quality, the speed of delivery and cost of products of both the experimental [3].

And test groups are shown below:

Quality of product, the speed of delivery and cost of the product (Pretest and Posttest)

The pretest and posttest were used to determine the difference that technology has on the quality of the product, the speed of delivery and cost of the product. Pretest: This was used to identify the company's products before the experiment was carried out. The data from the two months before the experiment were analyzed to establish the pretest results from both companies, Blender, and Strips. The low product quality, high cost and low speed of delivery were probably due to the cumbersome traditional method of production.

Posttest: This was used to test the level that technology has affected the product quality, cost and speed of delivery of the products. It was done by analyzing the data from the three months of the research.

Survey: The questions in the survey included the gender, years they have worked in the company and what they prefer about the company. The survey was done before and after the experiment

was done to be able to determine the working conditions in a technologically based company and traditional based company.

In the question and answers section, the questions included:
Is your environment safe to work in?
How many hours do you work in a day?
What is the salary if compared to tasks performed?
Days they have called in sick
The number of times they had to throw away a product and start a new when they spoiled the one they were working on?

This question and answer session was also done before and after the experiment was done to be able to determine the cost of human labor on the cost of final product.

Application

The study has been done on two companies in the Michigan area both producing blenders and was previously using the traditional method of production. The same researcher did the data collection and analysis.

Fully technological companies are those where robots have replaced humans, but apart from the company in China that has about 90% robots, most companies have not achieved that level of automation. It is the reason why it is important that humans and robots learn how to interact and work with each other to make life easier. Robotics in manufacturing companies are revolutionizing the industry step by step, and if the U.S does not keep up with its counterparts like China and Japan, then they will be left behind in the world of production. Technology is most commonly used to improve the quality of the products, reduce the cost and speed the delivery process between the consumer and the producer so they can get what they need fast and easier to them [26].

The period for the application of this experiment lasted about four months and covered all the working days from eight in the morning to evening. Within the study, the companies were given monitored daily, and the totals logged, those totals were turned into percentages at the end of the month.

Results

Comments to make up the basic make-up of the research result by employing the data analysis methods that have remained to the test and control group within the process of starting the study for evaluating data after the program has been applied and data collected [27]. The results that have been acquired through data analysis and evaluation has titles categorized according to their acquirement phases.

Result For the Pretest

The understanding of just how the test and control groups are ready for the application that has been prepared for the research and the pre-production value of the test and control group have been analyzed here. Formed the data, and they were analyzed by the program for statistics SPSS 16.0 for Windows [28].

The pretest values gave been analyzed for the November month period, and the data that was acquired is as follows:

Table 4: Analyzed Pretest Values for the Month of November

GROUPS	%QUALITY	%SPEEDY DELIVERY	% COST IN DOLLARS
TEST	54	67	1000
CONTROL	55	68	980

The table above shows the results of the total percentage of quality, the cost and the speed of delivery during November. In the test group, the percentage of quality was about fifty-four percent while the control group it was fifty-five percent. The speed of delivery percentage is about 67% for test group and 68% for the control group. The cost of the product is about 1000 for test group and 980 for the control group.

The pretest values have been analyzed for the December month period, and the data that was acquired is as follows:

Table 5: Analyzed Pretest Values for the Month of December

GROUPS	%QUALITY	%SPEEDY DELIVERY	% COST IN DOLLARS
TEST	56	68	1000
CONTROL	58	66	980

In this table, the percentage of quality of the test group was fifty-six while the control group was about fifty-eight. The percentage speed of delivery for the test group was sixty-eight percent while control groups were sixty-six. The price of the product remained the same with the test group selling their product at 1000 and control group at 980.

The result from combining this two tables into one mean table is used as the pretest.

The mean results acquired is as follows:

Table 6: Mean Table Used As the Pretest (Show the Mean Results)

GROUPS	%QUALITY	%SPEEDY DELIVERY	% COST IN DOLLARS
TEST	55.4	67	1000
CONTROL	56.5	65.3	980

The overall quality of products, speed of delivery, and cost of the product in dollars of December and November of both the test group and the control group have been associated by using independent sample test, and the information that was collected is in the table shown above. If we follow the table above and its findings we can say that the groups were assigned objectively in the groups with their merit. The table also displays that their no substantial difference between the two groups when they are both using the traditional method.

Results from the pretest and posttest have been acquired from the experiment, and the result from control group has been compared to that of the test group. If there is a major difference in the grades of pretest and posttest, it can be explained in the tables acquired. The table shows the test done at the end of the project to determine the quality of products, the speed of delivery and cost of the product.

First, we shall compare the pretest and the posttest results from the experiment Group:

Table 7: Comparison of Pretest and Posttest Results

GROUPS	%QUALITY	%SPEEDY DELIVERY	% COST IN DOLLARS
TEST	55.4	67	1000
CONTROL	96	92	400

As it can be seen in the table the experiment group that introduced the technologically based production and the delivery process had a higher product quality, higher speed of delivery to their client and cost of product went down by over a half. The quality of the product went up from 55.4% to 96%, the speed of delivery went up from about a 56% to 92%, and the cost went down from about 1000 to 400. The results show us that the technology-based manufacturing and delivery methods were successful in improving speed, reducing cost and improving the speed of delivery.

Table 8: The Pretest and Posttest for the Control Group Results

GROUPS	%QUALITY	%SPEEDY DELIVERY	% COST IN DOLLARS
TEST	56.5	65.3	980
CONTROL	55	67	1000

The information on the table above shows the quality of the product, the speed of delivery and cost in dollars of products in the traditional production and delivery process. We see from the table that the percentage of quality dropped, the speed of delivery had a difference of about 2.3, and the cost of product went up. Meaning that the consumer had a poorer quality product that was more expensive and the speed with which it was delivered was too slow. The Paired Sample Test was done to see if there is a major difference between the result of the pretest and final test of those products produced and delivered by traditional methods [29]. At the end of the investigation, it happened that there were no major differences between the result of pretest and final test of products produced and delivered using the traditional method. The result shows us that the traditional production and delivery process have no major impact on the company as it tends to stagnate.

When we look at the final test and the pretest we come up with the following table:

Table 9: Results of Final Test and Pretest

GROUPS	%QUALITY	%SPEEDY DELIVERY	% COST IN DOLLARS
TEST	96	92	400
CONTROL	55	67	1000

We see that there is a major difference be the quality, speed of delivery and cost in dollars of the test and control group. While in the test group the quality is high (96%), the speed of delivery is high (92%), and the cost is low (400). The control group the quality is lower (55%), the speed of delivery also lower (67%) and the cost of production is higher (1000).

In general, terms when we look at this final table both companies in the test and control group, it is observed that the company that technology-based methods of production were infused performed better than the more traditional setting. When we look at this situation, it can be said that technology improves the quality of products, speed of delivery and reduces the cost.

By this table provided, Independent Sample Test was carried out to evaluate if there is a noteworthy variation amid the result of the control group and that of the test group. At the final part of the program, the scattering of all the result collected at the pre-test and posttest that were carried out was also examined. The Levene's test was used to conclude if there is a major alteration amid the average results and the homogeneous variance [7].

Results from the Survey

The questions in the survey included the gender, years they have worked in the company and what they prefer about the company. The survey was done before and after the experiment was done to be able to determine the working conditions in a technologically based company and traditional based company.

Most of the employees at the pretest of both control and test group said what they preferred about the company was the fact that they worked there a long time and the management was loyal to them. Most of the post-test result of the control group was the same while the for the post-test about 67 out of 100 said that they now liked how fast paced the company had become.

In the question and answers section, the questions included:

Is your environment safe to work in?

How many hours do you work in a day?

What is the salary if compared to tasks performed?

Days they have called in sick

The number of times they had to throw away a product and start a new when they spoiled the one they were working on?

This question and answer session was also done before and after the experiment was done to be able to determine the cost of human labor on the cost of final product.

Results from a pretest of both the test and control company according to the majority of the workers:

Is your environment safe to work in? Most of them were not sure if they were safe and some expressed concerns about the old working manual machines in the company.

How many hours do you work in a day? The companies had 12 hours labor intensive shifts with a 12-hour break.

What is the salary if compared to tasks performed? Most of them thought that they were underpaid according to how much work they put in.

Days they have called in sick? The majority is ranging from one to five times in a month.

The number of times they had to throw away a product and start a new when they spoiled the one they were working on? Majority about 10% of what they worked on ended up ruined.

Results on the Control Group

For the control group, the answers remained almost the same because the environment to work in did not change at all.

Is your environment safe to work in? Majority complied that they were now confident with their working environment with new machines being introduced as long as they followed instructions.

How many hours do you work in a day? They still worked in the twelve hours shift, but most of the time the task just became monitoring to ensure that the machines were working properly. They realized that even 100 workers were too many compared to the amount of work that needed to be done.

What is the salary if compared to tasks performed? The majority said their tasks decreased.

Days they have called in sick? Still, one to five days but a majority also commented that even though they called in sick work did not stall.

The number of times they had to throw away a product and start a new when they spoiled the one they were working on? The number decreased to 1% to 5% of products that had defects.

Discussion

This questions helped determine the overhead cost of human productivity to how it will affect the cost of the final product, and the researcher discovered that when the operation is more human-based that the cost becomes higher compared to when the operation is machine based. In the technologically based company, the same amount of human labor that was used before became too much, and even if they called in sick, the production or delivery did not stall.

Conclusion

At the end of this research, it became apparent that technology improves the quality of the product, improves the rate of speedy delivery and reduces the cost than the more traditional methods.

The results of the research have been studied below as articles:

At the end of the pretest done before application of the program, there is not much difference between the test group who will have technology introduced and the control group that still uses the traditional method. The regular of the two groups is very adjacent to each other when the average is compared.

It has been noted that there has been a positive increase in the product quality, speedy delivery and low cost of the company that is technologically based.

It has also been noted that there is no much difference between the product quality, speed of delivery and cost of the company in traditional based methods of production. In fact, as the quality decreases the price has increased by about 20 dollars to be able to meet the bottom line.

It has also been noted that workers liked to work more in a technologically based environment with less work.

This study shows us that for the quality of products given to the consumer can be increased with technology. Technology can also make the process of delivering products to the client's easier hence increasing speed delivery, and it can also reduce the cost of production by producing more units with fewer people involved. Any technology that is introduced in the company makes life easier

for those working there and because of accuracy it improves the quality of the products. Companies should embrace technology more if they want to stay competitive and have a well-defined edge over their completion. This way they can achieve a lean manufacturing process and end up giving the correct products in the market, at just the correct time and in the correct quantity, this helps to eliminate waste [5].

A major concern in the technologically based system is that the machine or technological process may break down. Therefore, production and delivery will stall [16].

Another concern is the loss of jobs when companies become more inclined to technology [25].

My suggestion is that several people to be trained to work alongside the machines this way when they break down the whole process is not rendered useless. The training will also solve the issue of unemployment and thou the number of employees will not be as high as it used to be, some people will still secure their job.

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