

The Impact of Six Sigma Methodology on the Performance of Jordanian Pharmaceutical Firms

Mohammad Salameh Almasarweh^a, Eiad Basher Alhyasat^b, Firas Al-Rawashdeh^{c*}, Ahmed Atallah Alsarairah^d, Omar Alhawtmeh^e,
^aDepartment of Business Administration, The University of Jordan, ^bFaculty of Business – Al-Balqa Applied University Al-salt-Jordan, ^cDepartment of Risk Management and Insurance, Faculty of Management and Finance, The University of Jordan, ^dDepartment of Computer Information Systems, Faculty of Information Technology, The University of Jordan, ^eDepartment of Accounting, The University of Jordan, Email: ^am.almasarweh@ju.edu.jo, ^beyad.hyasat@bau.edu.jo, ^{c*}f_rawashdeh@ju.edu.jo, ^da.alsarairah@ju.edu.jo, ^eah_8545@yahoo.com, ^ea.alhawtmeh@ju.edu.jo

This study aims to show the impact of applying Six Sigma methodologies to the performance of pharmaceutical firms in Jordan. For the purpose of gathering the data a well-structured questionnaire has been developed and administered to the study population which included all staff and service recipients of pharmaceutical firms. The study sample consisted of all staff directly dealt with or related to the total quality management, which consisted of senior management and departments related to the overall quality, unit managers, and heads of departments. A correlational descriptive analytical method was used for data analysis, and hypotheses testing. A number of statistical tools and methods were used such as the arithmetic mean, standard deviation, and canonical analysis. The results showed there is an impact which is statistically significant at the level of significance ($0.05\alpha \leq$ standards for six sigma; continuous improvement, customer focus, prevention, commitment and support of senior management) on performance. Therefore, it has been concluded that the impact of Six Sigma on the firm's performance is an important topic and needs to be studied deeper, especially in the present time, due to its impact on the reality and the future of the surveyed firms. The study recommends that its highly needed to always gain the support of senior management to adopt Six Sigma style to improve services at pharmaceutical firms and consequently satisfy the customers' needs and desires.

Key words: *Six Sigma, performance, pharmaceutical companies, senior management, continuous improvement, customer focus.*



Introduction

Today's business environment faces problems with comprehensive changes in the way of production, marketing and many more, and therefore the sector must implement a sound modern policy to achieve competitive advantages and advise management to reach the production of ideal goods and services for clients. (Samarrokhi et al.,2015).

The industrial sector is one of the most important sectors contributing to economic growth in the Kingdom, as its contribution to GDP increased by 24.7 for the year 2018 compared to the late eighties by only about 18%. While the industry sector faces a number of challenges represented by a shortage of trained workers, difficulty in obtaining financing, and security conditions in the neighbouring regions, which led to the closure of the borders with Iraq and Syria, in addition to some legislations that have had negative effects on investment and industry. The importance of the industrial sector in the Jordanian economy, and the challenges facing the sector, made it necessary to develop and implement a national industrial policy. This order to enhance the competitiveness of the sector and increase its contribution to the process of economic development enabled it to increase its exports to traditional and non-traditional markets. (mit.gov.jo).

As for the pharmaceutical industry in Jordan, established in 1962, its exports have reached more than seventy-five markets in the world ranking the industry the highest in terms of value added to the local national economy due to its high quality, and its great competitiveness which is comparable to global industries. A number of strengths – long experience, management, control, development and research – are utilised to overcome the challenges and difficulties it faces in order to achieve such distinctive success. The therapeutic industries and medical supplies sector are important cornerstones and pillars of the industrial sector in particular, and the Jordanian economy in general. The pharmaceutical industry has made many popular achievements in the region because it relies on Jordanian manpower and competencies at various technical and administrative levels. (moh.gov.jo).

The world FDI stock in 1914 was 14 billion \$ and reached to 15, 602 billion \$ in 2007 (World Investment Report,1992,1995, 2008), which shows that the world market has become an open and competitive market. Any product sold in such a competitive market needs to be of a very high quality due to increasing consumer awareness of quality, fast technology transfer, globalisation and low cost competition. Therefore, the companies established long ago that produced such high quality goods implemented Quality Inspection, Quality Assurance , Total Quality Management and have developed a system that measures the defects per million called Six Sigma system therefore saving both time and money by being able to improve and develop their Business Performance (Al Kunsol, 2015), (Desale and Deodhar, 2014). Six Sigma is a set of techniques and tools for process improvement. The Six Sigma process is one in which



99.99966% of all opportunities to produce some feature of a part are statistically expected to be free of defects. (Tennant, Geoff ,2001). Six Sigma projects follow two project methodologies inspired by Deming's Plan–Do–Study–Act Cycle. These methodologies, composed of five phases each, bear the acronyms DMAIC and is used for projects aimed at improving an existing business process as well as projects aimed at creating new product or process designs (De Feo et al. 2005). (Lagrsoen, et. al., 2011) stated that the Six Sigma methodology is a flexible system for improving work management and performance development and it is one of the most common Methods of improvement in institutions in the past two decades as Six Sigma methodologies use statistics to measure performance. The goal of Six Sigma is to measure variation. Six Sigma techniques focus on reducing the variation, and thereby reducing defects. This results in quality delivery of output to customers. The benefits to organisations that embrace Six Sigma are; Increased profitability, Waste reduction, Drives Customer focus, Generates sustained improvement, Sets direction and goals.

Therefore, this study will take some of the Six Sigma elements as independent variables. Antony (2009) found that firms are using Six Sigma to improve quality through: quality level, customer satisfaction, market share, employees' moral, organisational culture, people development and return on investment. Jayaraman, et. al (2013) ensured that Six Sigma is an active approach to improve the organisation 's performance.

This study aimed to investigate the impact of Six Sigma on the performance of pharmaceutical firms in Jordan through such variables as: support of senior management, continuous improvement and customer focus as independent variables, and performance, as a dependent variable.

Due to the increase in the importance of the pharmaceutical sector there is the increase in competition, and the ease of entering the market as a new competitor, therefore the urgent need to search and explore new strategies to improve the quality of national products and improve production processes in Jordanian pharmaceutical companies. Since the Six Sigma approach is one of the strategies that contributed to improving the quality of products or reducing the deviations in quality this study strives to answer the following questions:

1. Is there a relationship between Six Sigma (commitment and support of senior management, continuous improvement, and customer focus) and performance in pharmaceutical firms in Jordan?
2. Is there a trace of Six Sigma (commitment and support of senior management, continuous improvement, and customer focus) and performance in pharmaceutical firms in Jordan?

Literature Review of Six Sigma

Background

Six Sigma as a concept emerged in the 1980s where the Motorola Company discovered the normal quality levels. At that time, the company did not meet the needs of its customers nor their expectations. Therefore, the company experienced customers' loss which was caused by reliance on the three-sigma methodology. This methodology reflected an increase in the cost of products for the high cost of reform (Captain, 2001). Six Sigma methodology aims to improve operations in the firms by reducing the rates of errors leading to raise the level of customer satisfaction and reduce costs. This study would guide and enable the pharmaceutical firms in Jordan to improve their performance significantly with respect to the basic structure and their operations, and through the values and continuous monitoring of their the activities of daily operations to reduce waste and the consumption of resources and to meet the customer's needs (Harry et al, 2008).

The successful implementation of Six Sigma methodology requirements (Almasarweh,2016)

1. Customer Focus.
2. Support and the support of the top management.
3. Personnel commitment and conviction methodology Six Sigma methodology for continuous improvement
4. An effective measurement system.

Obstacles related to the Application of Six Sigma Methodologies:

1. Default data on improvement projects
2. Changing customers' needs and expectations
3. Lack of the skills needed on the part of some employees in improvement projects (Jodeh, 2012).

Previous Studies

In order to form a conceptual framework for the current study to clarify the basic aspects of its subject, the researcher surveyed previous studies, and some studies that were related to the subject of the study were identified and their variables defined. The following is a review of some of these studies:

Basil's study (2012) *Application of Lean Six Sigma to Optimise Admission Waiting Time at AL-Mowasah Hospital*, investigated the application of Six Sigma to improve the waiting time in hospital and reported the extent of commitment to the Six Sigma standards to identify the level of patient satisfaction with the services provided and the impact this had on patient satisfaction in the hospital. Results of this study showed a great use of the principles of Six

Sigma to guarantee patient satisfaction. The study of (Adrian,2016) was trying to explain the importance of quality, and the continuous improvement of the quality and reach to fully satisfy each partner (customers, staff and other stakeholders) while also maintaining a competitive advantage, Therefore they used Total Quality Management, ISO certification, Agile & Lean manufacturing etc. but this paper found that there was nothing as effective as using: Thinking and DMAIC Six Sigma methodology. The research of Lee-Mortimer, A.(2007), aimed to detail the reasons behind adopting a successful process and the study found the introduction of a Six Sigma program within a leading, and award-winning in the UK manufacturing business. Kumar et al (2008) stated that such study found that the Six Sigma is at the top of the agenda for many companies attempting to reduce cost and improve productivity, and that the application of the optimisation models developed and results show that in some scenarios implementing Six Sigma may not be financially beneficial. The study of Firka, D., (2010) tried to investigate and explore how Six Sigma practices in Argentinian Institute for Quality. The results of the study could be beneficial to assess the situation of Six Sigma within an organisation and the obstacles and issues that could appear as the initiative evolves.

The purpose of the study of Yadav, et al. (2019) was to improve the yield of a particular model of a car windshield, due to the poor performance the organisation was facing. This paper describes Six Sigma methodology in a glass manufacturing industry in India for automotive applications. The overall yield of a car windshield reached to 93.57 percent compare to the historical yield of 88.4 percent citing that Six Sigma improved profitability and reduces defects in the studied manufacturing process. And (Smolenceva, A.&, Miftakhudinova, F.b, 2019), describes in their article the application of the Six Sigma Methodology on the example of the production process of micro assemblies, which had a high defectiveness. They concluded that Six Sigma Methodology reduces the release of defective products as the causes of defects are determined and corrected improving the quality of the micro assemblies. The project of (Thakur et al. 2019) was to improve the production process and reduce the cycle time of the entire piping installation process, and found the Six Sigma to be a set of techniques and tools for process and quality improvement by identifying and removing the causes of defects. Six Sigma methodology was found to be an excellent method of using statistical tools for examining the established piping installation process of a vessel construction.

Al Asas Bacel's, (2014) paper examined the Six Sigma implementation in the Syrian Pharmaceutical Companies. The most important findings of this research are the significant improvements achieved through the DMAIC project such as increased quality of the drug product involved in it, decreased the manufacturing process, and enhanced capability process to meet quality needed. And significant differences have been detected between the existing requirements in the studied company, and the needed requirements for the successful implementation of Six Sigma which included the required role of the company top management. But the resistance of employees were an obstacle for the implementation of Six

Sigma in the such a company. The study of (Leyer, M. & Chakraborty, A. 2011) believed that Six Sigma is considered to be an important management philosophy, and it finds that the financial service organisations have been slow to adopt Six Sigma even though the major importance of the implementation in such financial service organisations. And (Hyun Cho et al., 2011), aimed to determine the key ingredients of Six Sigma then identify suitable ingredients and complements in consideration of vision, strategies, capability, and circumstance of a company. The most important findings that 30 factors in 11 categories are concluded as the key ingredients of Six Sigma in such companies. And there is a significant difference in importance of Six Sigma key ingredients according to business type, company size, and implementation phase.

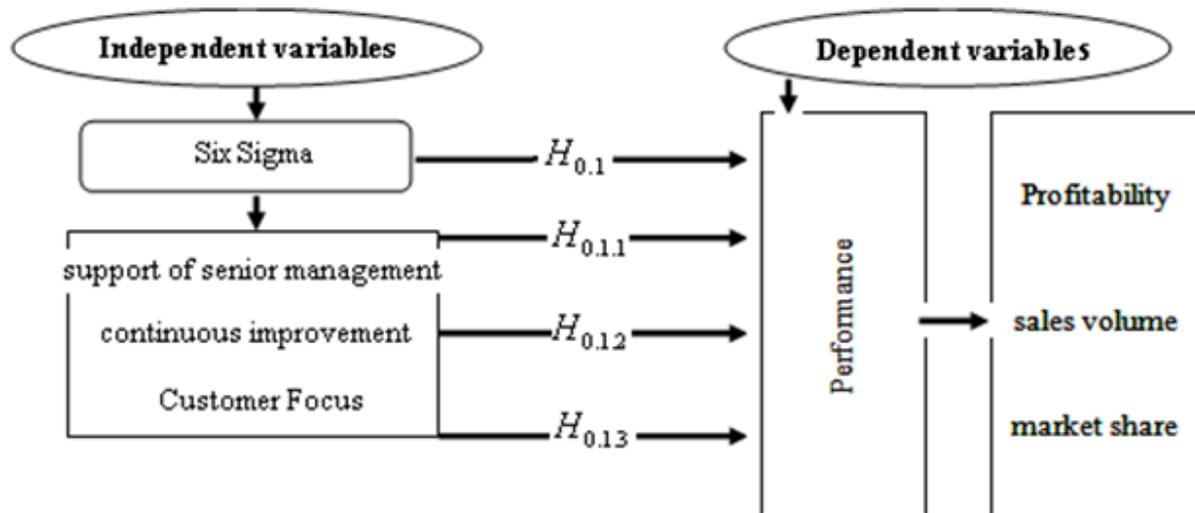
Another study of (Altork hana, 2016) aims at identifying the impact of using Six Sigma standards on the efficiency of the working capital management in companies listed on the Palestine Stock Exchange. The most important findings were the companies use of Six Sigma standards for each of the following criteria, respectively; feedback standard, capital management, standard of human resources, continuous improvement, operations and systems standard, and application of the standard of measurement. The findings show that there is a relationship between all Six Sigma standards and the efficiency of the working capital management except for the standard of systems and operations. And (Abu nahya jehan,2012) aimed to identify the extent of the use of Six Sigma methodology criteria to achieve quality of internal auditing, at the Palestinian universities in the Gaza Strip. The most important results from the Six Sigma methodology; support and commitment of senior management, processes and systems, continuous improvement, human resources, training, performance measurement and incentives, are available significantly. And Palestinian universities in The Gaza Strip is characterised by applying the standards of internal audit quality to a large extent.

Such study of (Al Kunsol William Hanna,2015) aimed of investigating the effect of Lean Six Sigma dimensions on the Jordanian Pharmaceutical Manufacturing Organisations' Business Performance, The results show that there is an agreement on high implementation of Lean Six Sigma variables, also the relationship between total Lean Six Sigma and Business Performance is very strong. The study of (Sameha Al_Nathar, 2017) trying to identify the extend of application of Six Sigma methodology in major food stuff manufacturing companies in west bank the study focuses on time element; top management commitment continuous, improvement proper human resources team process and information system feedback and measurement tools. The study finds that due to the availability at the application requirement it is very possible to apply the obstacles against apply meant. Six Sigma tools are very low as employee's resistance against modern changes. The most important recommendation is to train employee could try to adapt the Six Sigma tools. And the study of (Roa et al., 2014) aim to solve the problem at production fluctuation and bad product, the study concluded at some impartment recommendation as the management should have an clear vision and train the

employee a sound communication with all the level at management improve the leader capacity. The (Akbulut Yazan,2018) shows the effect of using Six Sigma approach as a competitive advantage in the Jordanian telecommunication company orang , Zain and Umniah. The study showed that all the Six Sigma dimensions: top management support , customer focus , use of specific standard measures , continuous improvement , human recourse management , and system efficiency have positive relation to competitive advantage. The study recommend that the company enhance their Six Sigma practice for achieving competitive advantage..(Noori et al. 2018) has shown that the company management found Six Sigma a sound method to be used in all companies for reducing the quality costs.

Suhas et al. (2017) was a study aimed at the factorial structure for Six Sigma project barriers and service industries and suggested five different constructs and management one of which the organisation can use to overcome any obstacle. The support of all levels of management during production helped the companies to apply the Six Sigma techniques. In the study of (Wuyts et al.,2015) it was observed that service providers have to reach customer satisfaction , the study showed that the company should look after the consumer needs. A study of (Al-Agbari and Al-Ghaili, 2015) determined the extend Six Sigma could be applied to Medicines factories in some pharmaceutical companies in the Republic of Yemen by examining all five Six Sigma dimensions. The study found that it is difficult to apply a Six Sigma method in the studied companies, but the application requirements could exist except for the availability of the necessary human resources for implementation. The purpose of this important paper (Alidrisi, H. ,2014) was to provide a practical approach for prioritising the most practiced Critical Success Factors (CSFs) for Six Sigma implementation. The outcome of the proposed ISM model that all factors for Six Sigma implementation were in fact critical. The study of (Raisinghani, M., et al. ,2005) provided a sound discussion on the Six Sigma methodology demonstrating how it fits in with other quality initiatives. The result shows that Six Sigma is defect reduction, this will lead to yield improvement and higher yields improve customer satisfaction. And (Rao, H.G. et al. ,2014) found that in recent years, an increasing number of companies have used different types of quality programs in order to increase internal and external customer satisfaction as well as to reduce quality cost. This paper explores the importance of Six Sigma in food industry, its history and a case study regarding dairy industry further some of the success stories of the firms after adopting Six Sigma concept. The study (Alrawashdeh, et al., 2011), concluded that there is a statistically significant effect of the seven principles of “Six Sigma” practices and the achievement of objectives of Jordanian Telecommunication Company and there is no a statistically significant differences which is related to demographics variables and the internal workers environment.

Research Model



Study Variables

- Performance is defined as the level of achievement of the organisation for its objectives in the diagram. (Ambler, etal,2004).
- Market share according to (Farris, et. al, 2010) is the percentage of the total market or part of the market being serviced, or the total sales of the company divided by the whole sale of the group.
- Profitability refers to the level of profits achieved by the organisation compared to Competitors (Chandra, 1997).
- Profitability is a measurement of return in the form of profits received (shareholders for their investments in the organisation (Armstrong, 2003).
- Sales volume equals the quantity of items a business sells during a given period.

Study Hypotheses

Hypothesis HO 1

There is a statistically significant effect of Six Sigma (commitment and support of senior management, continuous improvement, customer focus) performance on pharmaceutical firms in Jordan, e.g. (profitability, sales volume, market share) at a level of significance of 0.05. This give rise to the following sub-hypotheses:

Hypothesis HO1-1

There is a statistically significant effect of commitment and support of senior management performance on pharmaceutical firms in Jordan at a level of significance of 0.05.

Hypothesis HO1-2

There is a statistically significant effect of continuous improvement performance on pharmaceutical firms in Jordan at a level of significance of 0.05.

Hypothesis HO1-3

There is a statistically significant effect of Customer Focus Performance on pharmaceutical firms in Jordan at a level of significance of 0.05.

Research Design and Analysis

Stability of the Study Tool

The stability or the internal consistency of the instrument used in this study to evaluate response to paragraph was assured by means of Cronbach equation alpha (Cronbach Alpha, Table 1). The outcome is acceptable statistically if the value is greater than 0.70 (Sekaran, 2009). In addition, the results explain that the coefficient value stability is acceptable.

Table 1: Cronbach Alpha

n	Dimension	Questions	α (
1	Six Sigma	15	0.85
1-1	Commitment and support of senior management	5	0.83
1-2	continuous improvement	5	0.78
1-3	Customer Focus	5	0.86
2	Performance	5	0.89
	Questionnaire	20	0.82

As the above table shows, the Alpha Cronbach indicators on the suitability of the above study tool is generally high by a factor of stability and thus achieves the purposes of the study.

Results of the Special Six Sigma

The arithmetic mean is calculated, and the standard deviation and arrangement of the answers of respondents to the study vertebrae that measure the Six Sigma tools in pharmaceutical firms in Jordan. The results were as follows:

Table 2: Means and standard deviation of Six Sigma dimensions

Six Sigma	Mean	Std. Deviation	Rank
Commitment and support of senior management	3.46	1.980	4
continuous improvement	3.69	2.121	2
Customer Focus	3.85	2.032	1

Achieved variable customer focus the top centre of my account and was (2.85) and standard deviation (1.032) which indicates that the customer focus in the firms is high from the viewpoint of the sample level, has made the commitment and support of senior management variable central mathematically of (2.46) and standard deviation of (0.980).

The results of the special quality of pharmaceutical firms in Jordan

The arithmetic mean is calculated, and the standard deviation and arrangement of the answers of respondents to the study vertebrae that measure the performance in pharmaceutical firms in Jordan. The results were as follows:

Table 3: Means and standard deviation of performance dimensions

performance	Mean	Std. Deviation	Rank
profitability	3.2	2.3	3
sales volume	3.1	2.5	2
market share	3.9	1.2	1

Table (3) shows the performance in pharmaceutical firms in Jordan. From the standpoint of the respondents, as shown in the table above, the effectiveness of each level after the performance dimensions was a little different. It was the highest yet in terms of the level after safety, with a mean of (2.91) and a standard deviation of (1.116) and the level is high, and came after a response and a high level of reaching the middle arithmetic (2.89) and standard deviation (1.331), where the arithmetic mean of the post-physical aspects of the concrete was (2.80) and standard deviation (1.184).

Results and Testing of Hypotheses

Hypothesis HO 1

There is a statistically significant effect of Six Sigma (commitment and support of senior management, continuous *improvement*, customer focus) on performance (profitability, sales volume, market share) in pharmaceutical firms in Jordan at a level of significance of 0.05.

Table 4. The results of multiple regression contrast the impact of (commitment and support of senior management, continuous improvement, customer focus) analysis on performance (the dependent variable is the performance).

Dependent Variable														
performance														
R	R2	Df			Mean square		F	B			T		Sig	
		Regression	Residual	Total	Regression	Residual	Regression	Commitment and support	continuous improvement	Customer Focus	Commitment and support	continuous improvement	Customer Focus	
0.811	0.658													0.001
		4	56	50	2.7	0.03	170.1	0.33	0.25	0.1	3.12	3.27	0.64	

The results of Table (4) show the value of the coefficient of determination to be $R^2 = 0.658$. This means that the independent variable (Six Sigma) explains what percentage of discrepancy (66%) is in the dependent variable (the performance). Because the value of F is 165.23 at the significance level of <0.05 , we accept the hypothesis that there is a statistically significant effect ($0.05 \leq \alpha$) of Six Sigma on performance.

Hypothesis HO 1-1

There is no statistically significant effect of commitment and support of senior management on performance in pharmaceutical firms in Jordan at a level of significance of 0.05.

Table 5. Results of simple regression contrasts commitment and support of senior management performance impact analysis (dependent variable is the performance).

Dependent Variable										
performance										
R	R2	Df			Mean square		F	B	T	Sig
0.789	0.623	Regression	Residual	Total	Regression	Residual	Regression	0.8	40.1	0.005
		3	57	50	4.3	0.4	322.2			

The results of Table (5) show that the value of the coefficient of determination is $R^2 = 0.623$. This explains the rate (62%) of the discrepancy in the dependent variable (the performance). And because the value of F is 321.61 at a significance level of <0.05 , we accept the hypothesis that there is a statistically significant effect ($0.05 \leq \alpha$) to learn the performance.

Sub-third Hypothesis HO 1-2

Table 6 shows that there is a statistically significant effect of continuous improvement on performance in Jordanian pharmaceutical firms at a level of significance of 0.05.

The results of simple regression contrast the impact of continuous improvement on performance analysis (dependent variable is the performance)

Table 6

Dependent Variable										
Performance										
R	R2	Df			Mean square		F	B	T	Sig
0.722	0.521	Regression	Residual	Total	Regression	Residual	Regression	0.73	30.1	0.002
		3	57	50	5.8	2.1	400.1			

Results of table (6) show the value of the coefficient of determination to be $R^2 = 0.521$. This means that the independent variable continuous improvement explains what percentage of (52%) discrepancy is existent in the dependent variable (the performance). And because the value of $F = 397.3$ at a level significance <0.05 , we accept the hypothesis that there is a statistically significant effect ($0.05 \leq \alpha$) of continuous improvement on the performance.

Sub-third Hypothesis HO 1-3

There is a statistically significant effect of customer focus on performance in pharmaceutical firms in Jordan at a level of significance of 0.05.

The results of simple regression contrast the influence of customer focus on the performance analysis (dependent variable is the performance).

Table 7

Dependent Variable										
Performance										
R	R2	Df			Mean square		F	B	T	Sig
0.567	0.321	Regression	Residual	Total	Regression	Residual	Regression	0.4	21.2	0.001
		3	57	50	3.7	0.7	80			

Results in table (7) show the value of the coefficient of determination to be $R^2 = 0.321$. This means that the independent variable customer focus explains what percentage of (32%) discrepancy is present in the dependent variable (the performance). And because the value of $F = 79.35$ at a significance level of < 0.05 , we accept the hypothesis that there is a statistically significant effect ($0.05 \leq \alpha$) of skill on performance.

Conclusion

The study concluded with the following results:

1. Demonstrated by the theoretical literature that Six Sigma and performance is an important topic and sensitive to improve firms' performance, especially in the present time, due to its impact on the reality and the future of the surveyed firms.
2. The results showed that the performance of the first hypothesis, which eliminates the effect of the presence of a statistically significant at the level of significance ($0.05 \leq \alpha$ standards for Six Sigma (continuous improvement, customer focus, commitment and support of senior management) on the performance, so the first hypothesis is accepted.
3. The results proved the performance of imposition which requires the existence of a statistically significant effect at the level of significance ($0.05 \leq \alpha$) for the commitment and support of top management on the performance, so the second hypothesis is accepted.



4. The results showed the validity of the third hypothesis which requires the existence of a statistically significant effect at the level of significance ($0.05 \leq \alpha$) continuous improvement on the performance, so this hypothesis is accepted.
5. The results showed the validity of the hypothesis which requires the existence of a statistically significant effect at the level of significance ($0.05 \leq \alpha$) to focus on customers on the performance so it is accepted.

Recommendations

This study recommends the dire need for support by the senior management in adopting of Six Sigma methodologies. The study also recommends providing a suitable customer care to achieve their satisfaction through identification of needs and expectations of customers and to work on the improvement of the continuity of operations to meet their needs and expectations. Finally supporting employees of these firms and creating all favourable conditions to motivate them and sharpen their potential for creativity and excellence to achieve better performance. Further research suggestion; in response to several researchers (e.g. ALmasarweh et al, 2016; ALmasarweh, 2019), a comparative study should be conducted among different sectors in developed and developing countries to extract the best practices such as in using six-sigma methodology in the performance and then implementing them appropriately.

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