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Integrating DMAIC methodology and the TOC towards Quality Improvement in the Cosmetics Industry in Palestine

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Declaration

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I understand the nature of plagiarism, and I am aware of the University's policy on this. The work provided in this thesis, unless otherwise referenced, is the researcher's own Work, and has not been submitted by others elsewhere for any other degree or qualification.

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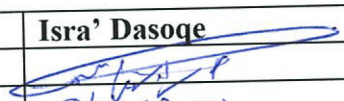
Signature	
Date	9/10/2021

Dedication

إلى أمي دائما، بوصلتي عندما تتيه بي الطرق

إلى أبي،،،

إلى شقيقي الأصغر الحبيب فؤاد الروح "محمد "

إلى اخوتي جميعاً لطالما كنتم سنداً لا يميل

إلى ملاكي الصغير الحب الوحيد والأوحد طفلي العزيز طارق

إلى الجنود المجهولون في طريق مسيرتنا إليكم أيضاً

أهدي نجاحي لكم وبكم تستمر الطريق,,,

Acknowledgment

He who does not thank people does not thank God. First and foremost, praise is to those who deserve praise always and forever, praise is to Allah, the Lord of the worlds.

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Abstract

The goal of this research was to find out if the integration of the DMAIC methodology and TOC positively affect the quality improvement of cosmetics factories in Palestine.

The study employed mixed methods in which the data were collected through quantitative and qualitative methods to explore the perspectives of 110 respondents from 22 cosmetics factories which were the study population. There was no sample size since the researcher aimed to study the whole population. To fulfill the research goals and test hypotheses; the data from the questionnaires were evaluated and analyzed using the statistical program (SPSS) version 21.0.

The study results came to a variety of conclusions, the most notable of which is there is a strong relationship between the DMAIC methodology and TOC, which leads to an improvement in the quality of the outputs when applying the integration between them. Also some cosmetics manufacturing companies in Palestine in a simple way apply the integration between the DMAIC methodology and TOC, as they identify the problems they face and the constraints on them; it also identifies opportunities for improvement and expected constraints during implementation following DMAIC methodology steps and some of TOC steps., TOC can save time, exertion, and cash when managing with measure imperatives and efficiency improvement objectives.

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List of Abbreviations

DMAIC	Define, Measure, Analyze, Improve, Control
TQM	Total Quality Management.
ISO	International Organization For Standardization
QM	Quality Management.
TPM	Total Productive Maintenance
LM	Lean Manufacturing
MPI	Manufacturing Performance Institute
TPS	Toyota Production System
NIST's	National Institute Of Standards And Technology
TIMWOOD	Alludes To Transport, Inventory, Movement, Waiting, Over-Processing, Over-Production And Defect Wastes.
TOC	Theory Of Constraints
IT	Information Technology
LSS	Lean Six Sigma
MRP	Material Resource Planning
SC	Supply Chain
DBM	Dynamic Buffer Management
ABC	Activity Based Costing
POOGI	Process Of Ongoing Improvement
B2B	Business To Business
SCM	Supply Chain Management
GDP	Gross Domestic Product
JIT	Just In Time
PDCA	Plan, Do, Check, Act Cycle
VMI	Vendor Managed Inventory
FMEA	Failure Mode And Effect Analysis
5M1E	Manpower, Machine, Measurement, Material, Methods And Environment
PLS	Partial Least Squares
SCOR	Supply Chain Operations Reference
CTO	Critical To Quality
DOE	Design Of Experiment
SPSS	Statistical Package for Social Sciences
PSI	Palestinian Standards Institution
DMADV	(define, measure, analyze, design, verify)
SOP	standard Operation Procedure
CI	Continuous Improvement

Chapter One: Introduction

This part of the research is composed of a simple introduction to the theme of the thesis, followed by the problem of the study, then the study significance and justification. the study objective, is followed by the study questions, and hypotheses, finally the limitations and obstacles that the researcher faced while working on this study.

1.1. Background

Many years ago, beauty was the focus of everyone's attention. From the ancient civilization of Egypt, we can notice people's interest in perfection and beauty in all details of life, and this is what cosmetics played a great role in. It has been concluded that the ancient Egyptians were the first to use a wide range of cosmetics, such as face cleansers, wrinkle creams, moisturizing, and many others, and that their use was not limited to women and was used by all classes, (El-Kilany and Raoof, 2017). In the 1980s Goldratt Had founded the Theory of Constraints(TOC) (McMullen, 1998). TOC's guiding idea was that any association is faced by a minimum of one obstacle that prevents management from pursuing the association’s or the company's objectives. Physical resources or strategies may be restrictions. To define and optimize such constraints, TOC develops a set of processes and methodologies. TOC uses a structured system that is composed of five measures for the purpose of continuous improvement (CI) (Goldratt and Cox, 1992). The application of Six Sigma system includes a serial number of measures designed specifically to promote

the continuous improvement (CI) process. The method takes the main development, devices, and flexible procedures of the entire process through the five phases of transformation: Define: identify client demands and a project that is fitting for the SS initiative. Measure: establishes what the output of the chosen phase is and how to calculate it. Analyze: understand and assess the factors that produce differences in quality. Improve: identifies ways of eliminating reasons of deficiencies and altering the process. Control: preserves enhancement. The primary aim of the five-step process is to understand essential customer needs, define and verify opportunities for change, and enhance business processes. (Ehie and Sheu, 2005)

1.2. Research Problem:

In today's business, companies are racing to obtain the best quality improvement tools (Nave, 2002). This is because the manufacturing sector has gone through many changes. In consideration of the economic environment and the progress of new manufacturing technologies, the firms' main goal became making more money to cover the high cost of the new technologies (Chede et al., 2012). Therefore, Chede,Jain et al., (2012) assumed that the main obstacles preventing companies from making more profit are the presence of capacity-constrained resources (CCR). For this study, more literature has been reviewed to find that in the last 20-years, using theory of constraints (TOC) in improving the firm's performance has rapidly increased, and also the area of implementing TOC has widely enlarged, as it is considered as the secret key to success is managing those CCR's, (Balderstone and Mabin, 1998). The cosmetic companies, which manufacture and import cosmetics

and sell them to the local market suffer from many problems. Namely, a high inventory and a low inventor's turnover; wasted resources; an increase in consumer complaints; an increase in returned goods; waste in labor costs due to a high reprocessing rate; a high defect rate, and overproduction. Combining the well-known DMAIC lean methodology with TOC would help in addressing and solving the previously mentioned problems.

1.3. Research Significance and Justifications

The importance of this study comes from the importance of personal care products in our everyday life and the increasing interest in the TOC. The finding(s) of the study will be beneficial to the cosmetics industry in the Occupied West Bank, Palestine especially in the present situation, which is affected by COVID-19. The study will help the industry to overcome the constraints that limit the factories from reaching the optimum situation and maximum profit. The study, will in turn, help and satisfy the concerned companies, its management, their employees, and their customers.

1.3.1. Contributions

The researcher believes in the importance of cosmetic products for both genders and all levels of society, in the importance of supporting local products, and the need for continuous improvement in the manufacturing industry in the Occupied West Bank, Palestine to maintain its competitiveness in imported goods. The researcher worked in a cosmetics factory for seven years then created a desire to develop the

performance of cosmetic factories. Therefore, the researcher will apply the TOC and the DMAIC methodology. Through collecting and analyzing the necessary data to study the obstacles that stand in the way of achieving better performance and reducing waste in producing high-quality cosmetic products, the researcher aims to choose the cosmetics industry since it is also a vital sector. The Palestinian market is full of imported cosmetics products, and this study will help the local factories maintain their ability to compete with imported products.

1.4. Research Objectives:

Knowing that the integration of the TOC and DMAIC positively affect the continuous improvement of organizations, then organizations can use this combination to help companies suffering from problems such as a high inventory turnover, a low-profit margin, an increase in consumer complaint, defects, and reprocessing by collecting and analyzing the data and providing suitable solutions.

The study seeks to pursue the following:

1. To identify the impact of integrating DMAIC methodology and TOC in the cosmetics industry.
2. To identify the root causes which limit the quality improvement in the cosmetics factories with regard to the DMAIC methodology and TOC;
3. To find the effects of the integrating of DMAIC methodology and TOC in reducing the cosmetics factories' constraints.

1.5. Study Questions and Hypotheses:

1.5.1. Study Questions:

1. What is the impact of integrating the DMAIC methodology and TOC in the cosmetics industry?
2. What are the main constraints that limit quality improvement in the cosmetics factories with regard to the DMAIC methodology and TOC?
3. What are the effects of integrating DMAIC methodology and TOC in reducing these constraints?

1.5.2. Research Hypotheses:

1. Integrating of DMAIC methodology and the TOC has a good effect on the quality improvement of the cosmetics factories;
2. There is a significant relation between the incorporation of the DMAIC methodology and TOC on quality improvement with alpha= 0.05.

1.6. The Study Scope

The scope of this study is, the factories that are completely specialized in the cosmetics industry or manufacture at least one type of cosmetics and also meet the Palestinian Ministry of Health licensing requirements, are only the factories that

interpolate the previous criteria were selected to collecting the necessary data. Managers and supervisors of the departments of quality, production and general manager of each factory were interviewed to fill out the questionnaire

1.7. Delimitations of The Study

1.7.1. The research covers the following features:

▪ **Geographical**: This research included the cosmetics manufacturing factories in the West Bank, Palestine.

▪ **Population and Sample**: 110 questionnaires from the respondents had been filled by interviewing the employees who head the quality and production departments specifically. There was no sample technique chosen since the entire study population have been covered to provide adequate data on reliability.

▪ **Knowledge:** On 13 April, 2021 contact was made with Mr. Youssef Rahal, the guild head of cosmetics factories and warehouses, to identify the target factories that were included in this study, accordingly, factories operating in the production of cosmetics were identified and licensed by the Palestinian Ministry of Health

▪ **Process and tool:** The study used a quantitative survey methodology to quantitate the target outcomes. A questionnaire was utilized to create the study procedure. The goal of the questionnaire was to meet the study objectives first, then to answer the study's questions, and finally to collect data to support the findings and hypotheses.

▪ **Time:** Questionnaires were distributed and the data needed for the study was collected over a period of two weeks, in May 2021.

1.8. Research Design

The research problem, research significance and justification, research objective, questions, and hypotheses were identified, then reviews of the literature about the research were reviewed and accordingly the literature review section was written and from it, the most important factors that were relied upon in writing the questionnaire were derived.

The questionnaire was judged by the thesis supervisor and five professors and doctors from An-Najah National University, Arab American University, and Al-Quds Open University.

After approving the questionnaire which fulfilled the requirements of scientific research and was appropriate to the subject and inquiries of the study, data were collected by distributing the questionnaire to the factories that were previously identified. The collected data was analyzed using SPSS version 21.0 software, finally, findings were summarized, and suggestions were made.

1.9. Thesis Structure

The chapters of the study are arranged as the following:

1.9.1. Chapter 1: Introduction

This chapter is composed of a general information to the thesis topic. And also the study problem and justification of the study, study goals, questions, hypotheses, study delimitations, and thesis structure.

1.9.2. Chapter 2: Literature review

This chapter contains the related studies that the researcher has studied. It also contains the data necessary for the reader to have clear and understandable images of basic concepts in quality management and continuous improvement. Emphasis was placed on understanding the DMAIC methodology and the theory of constraints and how they have been used throughout the years in developing the organization's performance and constantly improving quality.

1.9.3. Chapter 3: Study methodology

The study design and procedure are presented in-depth in this chapter. The methods utilized in the analysis, information and data gathering concerns are also described in this chapter.

1.9.4. Chapter 4: Data Analysis and Interpretation and discussion

In chapter four, the findings are presented and debated. The findings are presented and discussed after they have been analyzed.

1.9.5. Chapter 5: Conclusion and recommendations

Conclusions and recommendations were made in this chapter and also the study limitation included.

References, Appendices

Chapter Two: Literature Review

The chapter includes the assessment of the related literature applicable to the research topic, it also explains what total quality management is and what are the tools used for the continuous improvement concepts including DMAIC methodology in Six Sigma and TOC.

2.1 System Definition:

A system is characterized as a group of related procedures. A sequence could be a group of related links operating together towards the general objective. A constraint could be a deficiency, which all operations are stricken by (Nave, 2002). Since every system was built for a purpose, any constraint restricts the system from accomplishing a better performance and its objective (Goldratt, 1994). A number of the constraints that limit the course of a service or a product through the system were found during a six-sigma investigation (Nave, 2002). To optimize all the system resources, organizations tend to subordinate the non-constraining resources as per the necessity of their major constraints. This can be mainly achieved when the organization can identify its main constraints (Tabish and Nabil, 2013). And according to them, TOC has proved its ability to steer the method improvement and to guide the organization to induce the advantages of accelerated services, more

adaptability, and logical re-organizing of management priorities to reach maximum profit.

2.2 Choosing The Simplest Tool for Improvement

To choose the most effective tools to boost the organization's performance, one has got to study all the principles behind the suggested tools. When talking about improvement, the lean thinking method, the Six Sigma approach, and also the TOC come to the mind. Nave (2002) proposed a framework to decide on the most effective approach that suits each process; the framework includes a true comparison between the three development tools mentioned above, knowing the principle behind each tool, and eventually choosing one method. The Six Sigma is a system that centers on variation reduction when using the DMAIC guidelines. Lean thinking may be a method that removes waste by concentrating on the flow. The TOC manages process constraints. An organization can also use more than one tool (Nave, 2002).

Table 2.1: Nave improvement framework

Program	**Six Sigma**	**Lean Thinking**	**Theory Of Constraints**
Theory	Reducing Variation	Remove Waste	Manage Constraints
Application Guidelines	1. Define. 2. Measure. 3. Analyze. 4. Improve. 5. Control.	1. Identify Value. 2. Identify Value. Stream. 3. Flow. 4. Pull. 5.Perfection.	1. Identify constraint. 2. Exploit Constraint. 3. Subordinate. Processes. 4. Elevate constraint.

Focus	Problem Focused	Flow Focused	5. Repeat Cycle. Systems Constraints

Generally, the shortage of methodological disciplined analysis may be a major imperfection of small and medium enterprises. Still, some serious and subjective observations are more important than impartial evaluation in the process of quality control resolutions. Accordingly, the implementation of the TOC will help to point out the need of using methodical analysis and Total Quality Management (TQM) tools in decision making, especially if it's quality-related. (Shamsuddin and Masjuki, 2003).

2.3 What Is Total Quality Management

Total Quality Management (TQM) started in 1951, yet it took off as an interaction improvement strategy utilized in the 1970s and 1980s which intended to make the whole organization think about the need of the requirement to measure improvement so as to enhance the productivity of the management, the nature of the end result, consumer loyalty and eventually cause a more beneficial association (Banuro, Ntiri-Ampomah & Banuro, 2017, Kumar, et al., 2018; Anthony et al., 2017). The difficulty with this philosophy is that there have been no principles founded and systems are hazy (Harnesk and Abrahamson, 2007). TQM's deficits as per Black and Revere (2006) are the main driver of issues that are not being detected while Dahlgaard-Park (2011) expressed that TQM's shortage because the absence of concurrence on its definition and also the right usage by certain associations.

Gershon (2010), Sabet et al. (2016), and McLean et al. (2017), all concurred that TQM needs the board to uphold changes to persistent improvement, and a philosophy that considers replicability. Ng, Rungtusanatham, Zhao, and Ivanova (2015) suggested that changes and other philosophies need to be reviewed during TQM usage.

Kearney (1991) reasoned that TQM contains a disappointing percentage of 80% and that it comes up short in achieving economic upgrades. Youssef and Youssef (2018) expressed that competitiveness, performance, and quality administration are the basics for a producing company to accomplish an elite manufacturing position. TQM oversees quality; however, it is deficient in other items.

Gershon (2010) contended that TQM is good for all practice enhancement strategies while Mclean et al. (2017) expressed that TQM was a greater amount of thought, with numerous conflicting administration rehearses, that failed to permit reproduction. Kumar, et al. (2018) and Banuro et al. (2017) concurred that there is a shortage of official TQM frameworks or systems and that there are various designs created by various organizations. All together for a procedure to be reproducible, it requires a structure to be actualized.

It can likewise be contended that TQM is certifiably not preferred by people because TQM's execution course of events is 3-4 years when contrasted with Theory of Constraints (TOC), Lean assembling, and Six Sigma which is conventionally 1-2 years (Kumar, et al., 2018). The ISO 9001 Quality management framework has likewise been connected to TQM since enterprises use ISO 9001 Quality

Management (QM). (Askey & Dele, 1994) contended that ISO 9001 QM framework (ISO 9000 during that time span) is the sensible following stage from TQM while Poksinska, Jörn Dahlgaard, and Antoni (2002) contended that ISO 9001 QM framework is somewhat a subtype of TQM. Youssef and Youssef (2018) contended that TQM and ISO 9001 QM framework are not replacements and must be managed as different approaches. In 1999, Terziovski, Sohal, and Moss previously expressed that TQM prevalence has diminished while ISO 9001 license has expanded. Along these lines, the ISO 9001 QM framework was inspected independently.

2.4 ISO 9001 Quality Management (QM) System

The International Standards Organization (ISO) started in 1946 when agents from 25 nations gathered to make an institute that encourages the creation of standards for different kinds of industry to help improve quality (Rokke and Prakash Yadav, 2012).

Kumar, et al. (2018) expressed client dissatisfaction, inward dismissals, and nonconformities which are reactive measures, unlike Six Sigma which screens measures capacity varieties which is supportive of dynamic methodology. (Cauchick Miguel & Celso Sobreiro Dias, 2009) concurred that ISO 9001 QM framework is responsive because it cannot ensure item quality yet rather surveys the nature and quality of tasks. Six Sigma has a better value, adding commitment evaluation of cost investment funds and task direction center unlike the ISO 9001

QM system, which recognizes its worth added by Standard Operating Procedures (SOP's), inside reviews, and the reviews by management (Kumar, et al., 2018).

Wu and Chen (2011) contended that ISO-ensured fabricating organizations exhibit extensively better in all zones than unlicensed ones. Kumar et al (2018) deduced that there is a beneficial impact on an association's exhibition that has adopted TQM, Total Productive Maintenance (TPM), and Lean Manufacturing (LM) yet it is not the situation for an ISO 9001 QM framework. The ISO 9001 QM framework is a decent affirmation instrument to providers, clients, and partners if you need to show quality control in an association through being approved (Kumar et al, 2018). It is anyway a management system instead of an improvement philosophy.

The ISO 9001 QM framework is acknowledged as a prerequisite for successful worldwide business as indicated by Denton and Maatgi (2016). Denton and Maatgi (2016) and Poksinska et al. (2002) suggested that ISO 9001 QM framework advantages are to boost client satisfaction, to offer better tenders' bids, and are generally utilized as an advertising device or it very well maybe because of government rules. These do not adjust to the prerequisites for an improved system.

The Manufacturing Performance Institute (MPI) also does not confirm ISO 9001 QM system as an enhancement technique and characterize it as some kind of certification (The MPI Group, 2014). The ISO 9001 QM framework has not altogether enhanced the quality of items and was not put as an upgrade or enhancement program (Quazi, Hong and Meng, 2002). ISO 9001 doesn't distinguish quality matters and it is an assortment of principles that control documentation

concerning quality frameworks and is truly unyielding (Krajewski and Ritzman, and Malhotra 1999; Pfeifer, Reissiger and Canales, 2004). The Manufacturing Performance Institute (MPI), anyway sees Lean Manufacturing as an enhancement method (The MPI Group, 2014).

2.5. Lean Manufacturing

Lean Manufacturing was created by Toyota Production System (TPS) and focuses on dispensing with misfortunes and expanding benefits. Lean Manufacturing's essential aim is to decrease squander and make a simple stream between production processes (van der Krogth, Gerathy, Salman and Little, 2010; Antony, Kumar and Madu, 2005). Lean Manufacturing, just like The Theory of Constraints, calls for the enhancement of the quick progression of material (Moore and Scheinkopf, 1998).

The National Institute of Standards and Technology (NIST's) Manufacturing Extension Partner (MEP) characterizes Lean Manufacturing as: " A systematic approach to identifying and eliminating waste through continuous improvement; flowing the product at the pull of the customer in pursuit of perfection " (NIST, 2003).

The seven kinds of squander, called Seven Muda in Japan, was distinguished by TaiichiOhno (the dad of Toyota Production Systems) in 1988 and is pronounced as TIMWOOD to review it effectively (Chan and Tay, 2018). TIMWOOD alludes to transport, inventory, movement, waiting, over-processing, overproduction, and defect wastes (Spector, 2006; Chan and Tay, 2018). At the point when the Toyota

Production System was embraced in the Western world and when Lean Manufacturing and Six Sigma were brought together, the 8th waste in particular abilities or otherwise called unutilized ability was presented (Skhmot, 2017).

A favorable position of Lean Manufacturing is that by terminating waste you can likewise diminish handling time (Bentley, 2011). Then again it doesn't consider the framework to be examined in general, however rather relies upon numerous little upgrades at different processes (Bentley, 2011).

Lean Manufacturing additionally puts functions into the accompanying classes (Van Tonder, 2011):

1. Value adding (An adjustment in the highlights, nature, or type of an item by a cycle adjusted to client necessities)
2. Non-Value adding (An interaction that does not raise item value, however, is important)
3. Waste (Functions can be terminated quickly because they do not raise item value and are trivial.

The Lean Manufacturing sanctuary as made by Toyota can be perceived in Figure 1. The establishment is based on a coordinated working environment, visual execution procedures, standard operating procedures, critical thinking, and Total Productive Management (TPM) where everyone investigates, cleans, and looks after machinery (Liker, 2004). TPM anyway is not contemplated as an enhancement procedure itself as it is concentrated on independent and arranged upkeep exercises requiring association from floor laborers (Kumar et al., 2018). It isn't just a mainstay

of Lean Manufacturing, but can additionally be free to other enhancement speculations like TQM with lower enhancement development (Stamm, Neitzert and Singh, 2009)

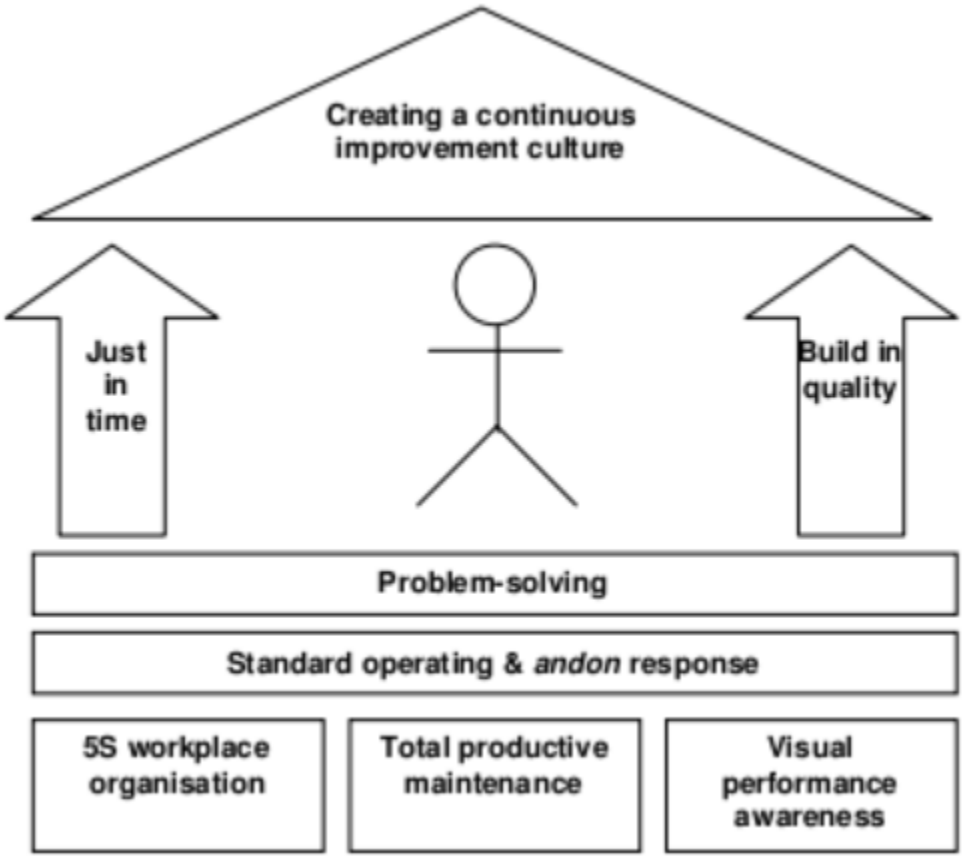

Figure 2.1. **The Lean Manufacturing temple (Van Tonder, 2011)**

Lean assembling's low inventory causes a desire to move quickly and different processes are additionally influenced when an interaction stops (Van Tonder, 2011). The thought is the executives will be compelled to determine the issue and discover the main issues causing the problem because the business is affected too (Van

Tonder, 2011). This is anyway not an economical methodology as proceeded with misfortunes which the business is not cushioned against can make it shut down.

Unlike the Theory of Constraints (TOC), Lean Manufacturing suggests a fair plant. As indicated by Bhamu and Singh Sangwan (2014), provider reconciliation and dissemination frameworks have thought that it was hard to execute Lean Manufacturing procedures because of contention among them and the production and customers' needs to various market requirements. This is the place where TOC is helpful. Stoll (2011) argued that Lean standards are not put in where they can give organizations the most value for their money and Lean projects are regularly seen as an agenda of does and does nots. TOC can help to give this concentration yet cannot do this by itself if not supported as an essential activity upheld by the work.

Even though there are numerous instances of accomplishments through Lean Manufacturing, organizations have difficulties remaining on target and 36% of the Lean experts expressed that falling away from the faith to old methods of work is the principal dispute (Spector, 2006). This may be expected to be generally utilized company-wide that makes any kind change troublesome (Cheng, 2017). It is still reviewed as the only way to progress in the industry (Netland and Ferdows, 2016). This may be because of Lean Manufacturing and IT (Information Technology) being firmly connected in order to lessen costs, companies and organizations have gone to IT (Pinho and Mendes, 2017).

Lean Manufacturing is firmly identified with TQM in that organizations frequently utilize both, yet the analysis is that they are not focused on where and how their

belongings will have the best effect, however a sweeping methodology is utilized where Six Sigma can uphold.

2.6. Agile Manufacturing

An organization's capacity to a quick react to changes in an energetic and unstable market to be resilient and precisely meet forceful client necessities are alluded to as Agile Manufacturing (Abdallah & Nabass, 2018). Abdallah & Nabass (2018) were of the conclusion that Agile Manufacturing will lead to Lean Manufacturing and noteworthy influence on procedural execution. Lean Manufacturing should shape the establishment of Agile Manufacturing due to the use of some of its definitions (Potdar et al., 2017; Gurahoo, 2015). Potdar et al. (2017) argued that cost decrease is imperative in manufacturing and Agile Manufacturing does not center on this goal but or maybe on response. Iqbal, Huq & Bhutta (2018) expressed that Lean Manufacturing and Agile Manufacturing follow the same goals to be specific preparedness advancement, quality, and competitive prices.

Lean Manufacturing contains all the components of Agile Manufacturing and they are connected (Iqbal et al., 2018; Bortolotti, Danese, Flynn, & Romano (2015). Agile and Lean Manufacturing techniques are commonly strong (Bhamu & Singh Sangwan, 2014). Therefore the contention is to continue with utilizing Lean Manufacturing specifically. Lean Manufacturing and Agile Manufacturing have been denounced for not using statistical and qualitative analysis which is Six Sigma's essential power and hence Six Sigma was considered.

2.7. The Six Sigma

Six Sigma is a way to measure enhancement through a decrease in fluctuation and was first acquainted at Motorola in the mid to late 1980s (Anthony et al., 2017; Hayler and Nichols, 2007; and Pyzdek, 2003). Its essential expectation is to balance out. In statistical analysis, sigma (σ) quantify the inborn fluctuation of a cycle which is known as the standard deviation. A low standard deviation ought to enhance operations quality and execution just as bringing down the chance of disappointment (Cheng, 2017).

Chiarini (2013) expressed that TQM and Six Sigma can endure each other in an association. In contrast, Sabet et al. (2016) just as Näslund (2008) contended that Six Sigma ought to be based on TQM principles and that Six Sigma is an advancement of TQM. Gershon (2010), Antony et al. (2005) and Pande, et al (2000) expressed that Six Sigma conquers the shortages and is an enhanced rendition of TQM. Pande et al. (2000) additionally expressed that Six Sigma is presently regularly utilized in associations because of progress and support the nature of procedures being basic in any kind of work. Six sigma is viewed as TQM 2.0. It plans to accomplish a business with no mistakes and is driven by focused utilization of realities, information, and measurable investigation (Gershon, 2010).

Six Sigma's orderly and organized technique has acquired far and wide industry acknowledgement due to its concentration on client demands and its primary concern. Data and statistical analysis and quality control and quality assurance have been the few strategies and apparatuses created by Six Sigma (Prashar, 2016). As

indicated by Stamm et al. (2009), TQM and Lean Manufacturing are not as directed on quick and substantial outcomes and do not explain how to adjust the structure, and do not use statistical analysis when contrasted to Six Sigma.

A favorable position of Six Sigma is that decreasing variety in the procedure makes consistency in the yield (Bentley, 2011). This is significant as ceaselessly enhancing a framework that has a great deal of inconsistency or is shaky is a challenge (Hudson, 2017). As with Lean Manufacturing, Six Sigma abstain taking into consideration the framework to be investigated as a complete system but rather takes a gander at different steps freely. Also, interactions between the different steps are not for the most part contemplated (Bentley, 2011). Systems like TOC and Lean Manufacturing can decrease the interruptions that increase in stockpile can create particularly when changes in quality and output have been diminished (Schmenner, 2012). That is the place where Six Sigma can help TOC and Lean Manufacturing.

Six Sigma requires higher degree of comprehension of applied data and statistical analysis through Lean Manufacturing requires just fundamental mathematical activities (addition, reduction, multiplication, and division) (Bentley, 2011). This may clarify why Lean Manufacturing is more famous than Six Sigma and why Six Sigma is viewed as an esteemed capability. Anthony et al. (2017) and Prashar (2016) expressed that the impediments of Six Sigma are that it requires consolidation into the current administration frameworks, it needs a hypothetical background, it takes an excessively long time for information investigation, absence of activity and afterward it is disconnected from the work methodology.

The fundamental contrast between Six Sigma and Lean Manufacturing is that the first centers to lessen errors; it depends on statistical analysis and is information-driven where the last is focused on diminishing non-value-add measures, best practices and is perception driven. Both require a difference in the attitude of employees and the administration of an institute (Banuro et al., 2017). Anthony et al. (2017) reported that since Six Sigma and Lean Manufacturing (Figure 2) both created results, they are somehow limited on their own, therefore combining both systems look logical and better for business. That is why the Lean Six Sigma improvement system was created.

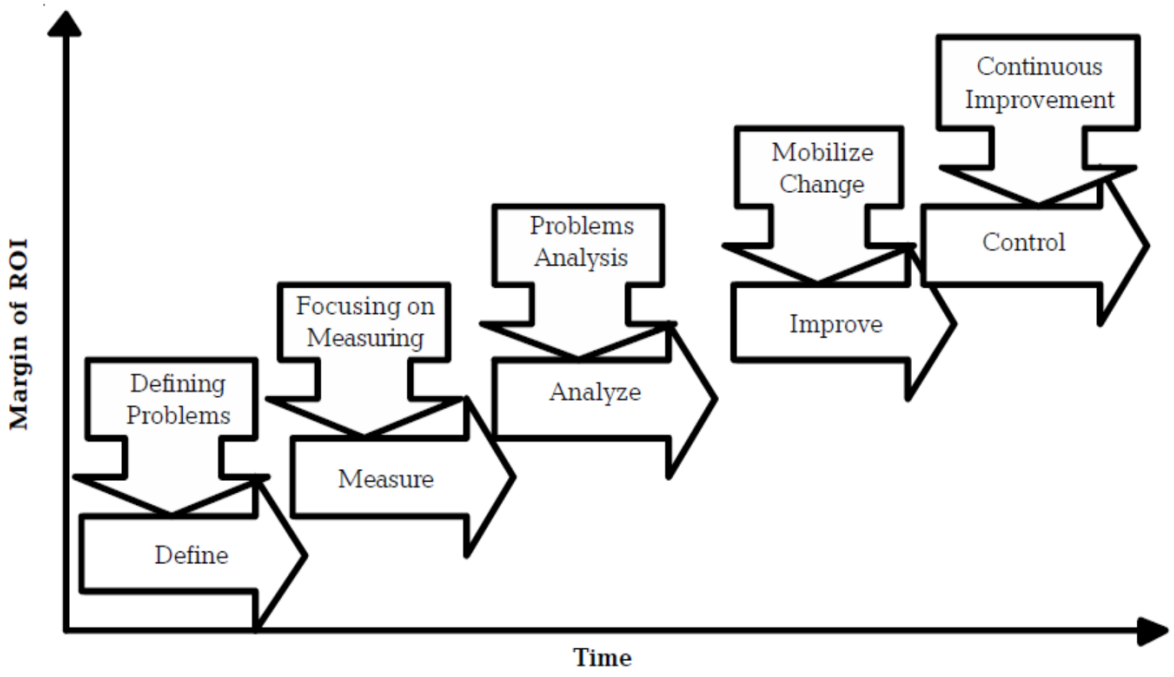

Figure 2.2. **Six Sigma DMAIC frameworks (Cheng, 2017)**

2.8. Lean Six Sigma (LSS)

Bhuiyan and Baghel (2005) and Antony et al. (2017) contended that Lean Six Sigma (LSS) has become the most liked and perceived business measure improvement approaches. (Albliwi, Antony, and Lim 2015) expressed that executing LSS guarantees that an organization stays in rivalry and increments consumer loyalty, it improves item quality and manufacturing tasks, increments main concern investment funds and top-line development, and diminishes low-quality expenses. In manufacturing LSS anyway still have the accompanying impediments: an economical system, absence of normalized programs, no universally acknowledged guidelines, and not too many distributed contextual analyses (Antony et al, 2017).

Sig Sigma methods require an association to be just about as Lean as could be expected (Pepper and Spedding, 2010). The test with this selection is that the perfect Lean Manufacturing condition is very troublesome. Stamm et al. (2009) contended that Lean centers on procedure interrelationship, being fast, and how it flows, while Six Sigma's DMAIC gives a higher perspective view and system steadiness.

Although Antony et al. (2018) contended that LSS should be utilized for extensive improvement, they further expressed that LSS should be improved to concentrate on critical issues facing any process. Stamm et al. (2009) concurred that the technique above needs enhancement as 60% of Lean Six Sigma activities fall flat and car producers are as yet unfit to duplicate the achievement of Toyota because of the requirement for an incorporated methodology. This is the place where TOC can help.

A suspicion from Lean Manufacturing is that work execution will naturally enhance if waste is diminished and Six Sigma expects generally the framework will enhance should fluctuation be decreased all over the place (Spector, 2006). Once more, the high disappointment pace of these activities may be expected due to the excessive number of ventures, and the ones that can give the best effect, are not standing out enough to be noticed.

The best way to upgrade business execution using Six Sigma is through the DMAIC interaction (Cheng, 2017). The explanation this investigation zeroed in on the DMAIC cycle is because 80% of Six Sigma enhancements come from this system (Hudson, 2017). The improvement structure of LSS can be found in Figure 3 below:

(Arnheiter & Maleyeff, 2005) reported that an association that actualizes Lean Six Sigma would have the option to utilize its activities by guaranteeing it is a value-adding, favors worldwide business rather than a local business, settles on client-driven and information-driven choices, and limits quality changes.

(Byrne, Lubowe & Blitz, 2007) concluded that Lean Six Sigma worries are doing things better. The dilemma is it does not show how to do this or when to do it. TOC can help in showing how to do this.

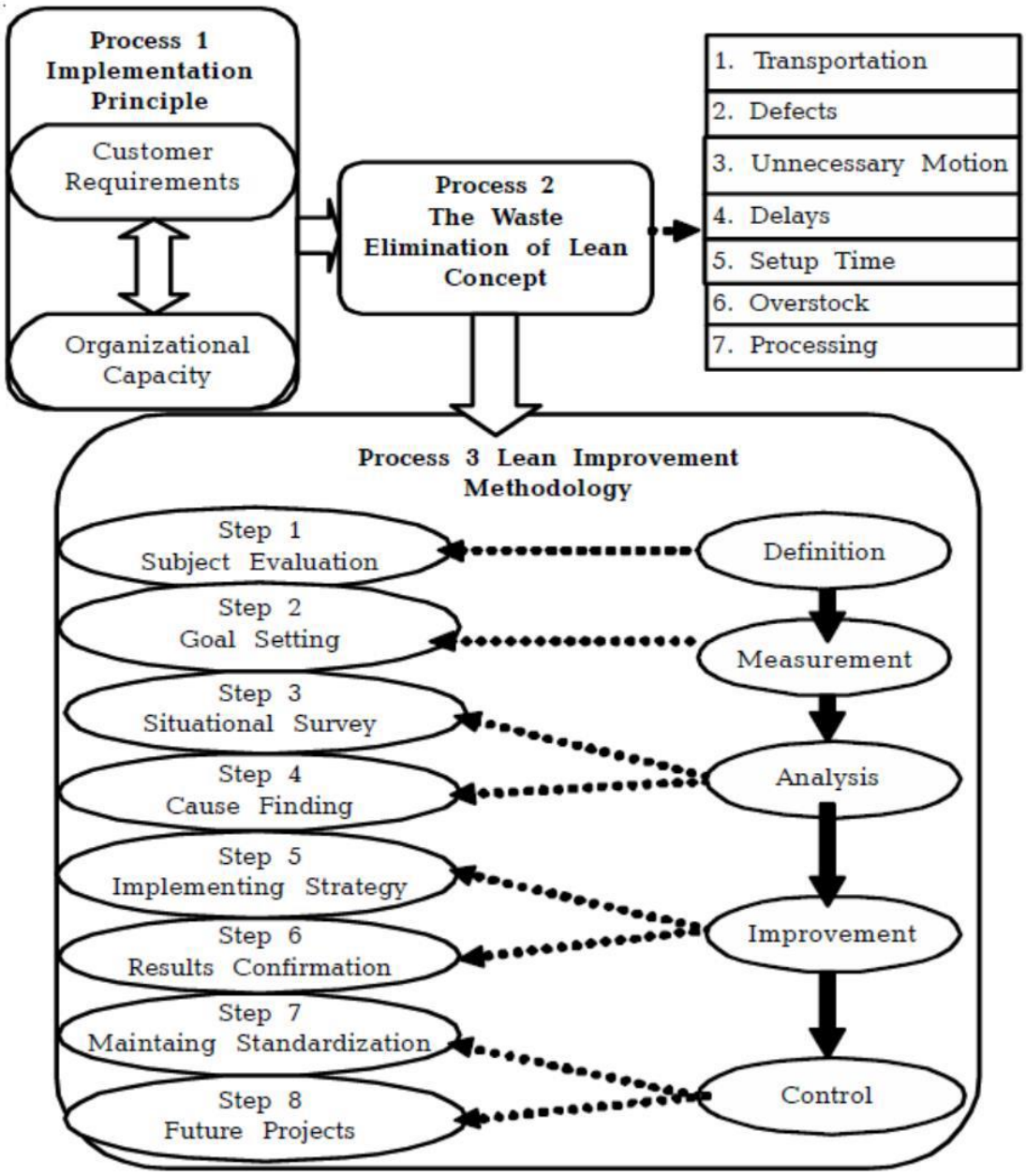

Figure 2.3. **LSS framework (Cheng, 2017)**

2.9. Constraints Theory

Theory of Constraints (TOC) was initially thought about by Eliyahu Goldratt in the 1980s and its emphasis is on overseeing limitations and creating advantages (Coman

and Ronen, 1995). TOC's essential aim is to organize and harmonize all aspects of the plant. Since production measures are dependent, it breaks this reliance by setting a mandatory capital to the limitation (Mabin and Baldersone, 2003). Interestingly, Lean Manufacturing states that inventory or cushions such as mandatory capital block problems do not permit them to surface and this will be costing you cash to convey (Schmenner, 2012).

As per Sabet et al. (2014) and Cook (1994), TOC has ended up being exceptionally viable and fruitful, it offers a more extensive implementation than Lean Manufacturing does and is elevated to have better results (Cook, 1994). Moore and Scheinkopf (1998) reported that Lean Manufacturing usage is valuable, however much more so whenever applied at the organization’s repressing perspectives.

TOC requires three basic inquiries in connection to an organization's continuous interaction enhancement (Gupta and Snyder, 2009):

1. What requirements need to be changed or what organizations need to do to characterize their most vulnerable connection?

2. What should the most vulnerable connection switch to? What great and reasonable arrangements should be utilized to fortify the most fragile connection?

3. How must the switch be carried out or how can the solutions be executed?

A preferred position of Theory of Constraints is recognizing the critical step in the production cycle and tending to this, the work accomplishes a quicker throughput and produces excellent outputs. (Bentley, 2011; Creasy, 2014). TOC is by all

accounts the lone autonomous cause of improvement strategies which makes manufacturing worldview advancement and demonstrates super results when joined together with other enhancement techniques (Stamm et al., 2009).

Boyd and Gupta (2004) contended that for TOC to do the job and be completely actualized, an organization should move in dynamic estimation frameworks identified with execution and the organization's way of thinking as found in Figure 4 below. Even though TOC centers around the limitations, it requires the entire association to be directed towards production augmentation through managing the limitations (Boyd and Gupta, 2004).

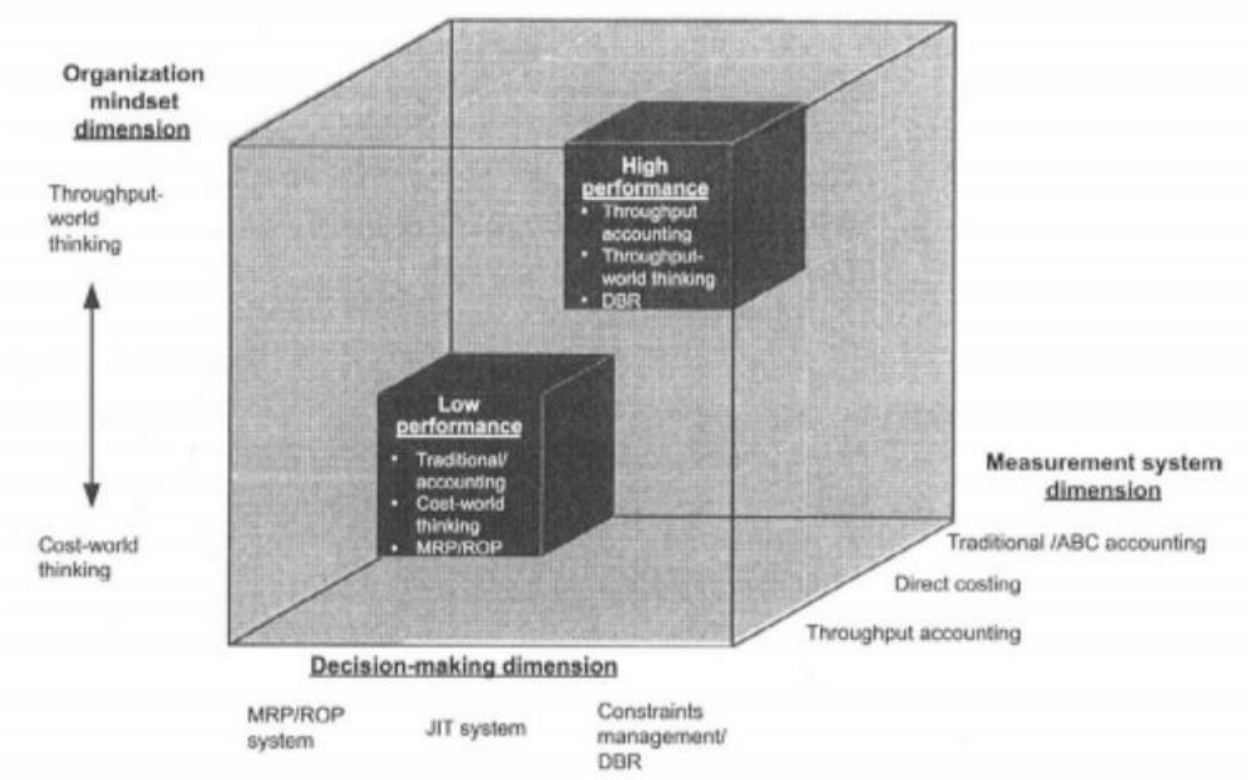

Figure 2.4. Three dimensional throughputs oriented thinking (Boyd and Gupta, 2004).

Bentley, (2011) reported that a few reactions of Theory of Constraints are that information testing is not as worth compared with Six Sigma. Additionally, an insignificant contribution from laborers is thought of. A different analysis of TOC is that now and again the constraint interaction is influenced by the inconsistency of non-constraint cycles and its presentation is restricted because of it not taking a gander at these fluctuations of non-constrained measures (Filho and Uzsoy, 2014).

Moreover, other disapprovals of TOC are that, no genuine clearness on the best constrained area, is there; furthermore, its failure to manage intangible problems, and lastly that there is no unmistakable good sign on when to carry on with the subsequent stage (Pretorius, 2014).

TOC supporters have scrutinized that Material Resource Planning (MRP) is not an enhancement strategy, however, that it needs precise lists of stock, bills of substances, and orders (Boyd and Gupta, 2004). MRP is significant however it is a non-value adding procedure (Lean Manufacturing), it does not expand item worth but it is essential.

Contrasted with Lean Manufacturing's objective of looking for flawlessness, TOC probably won't be as glamorous by decreasing limitations, yet because of the intricacy of the present organization, the influence needed to be set up (Moore and Scheinkopf, 1998).

Figure 5 demonstrates the five TOC focusing ventures including choice phases as evolved by Pretorius (2014) which help to frame the premise of a coordinated cycle enhancement design using TOC. There was no change in the first step. A choice

step was made between stages 1 and 2. The contention is that at first, the limitation will be evident and tangible, however as the cycle has been repeated, the limitations can become intangible (Pretorius, 2014).

Pretorius (2014) has not switched the cycle between stages 2 and 3, however after step 3 two resolution steps have been made. Step B confirms that the correct limitation was selected (Pretorius, 2014). Submission will not be conceivable if some unacceptable constraint is picked (Pretorius, 2014). Step C1 decides whether the non-constraints are to be shattered. As opposed to Lean Manufacturing, TOC does not support a fair plant because it will annihilate the course as per Pretorius (2014). A fair plant taking advantage of conditioned occasions and statistical variances diminishes production and expands stockpile (Goldratt and Cox, 2016).

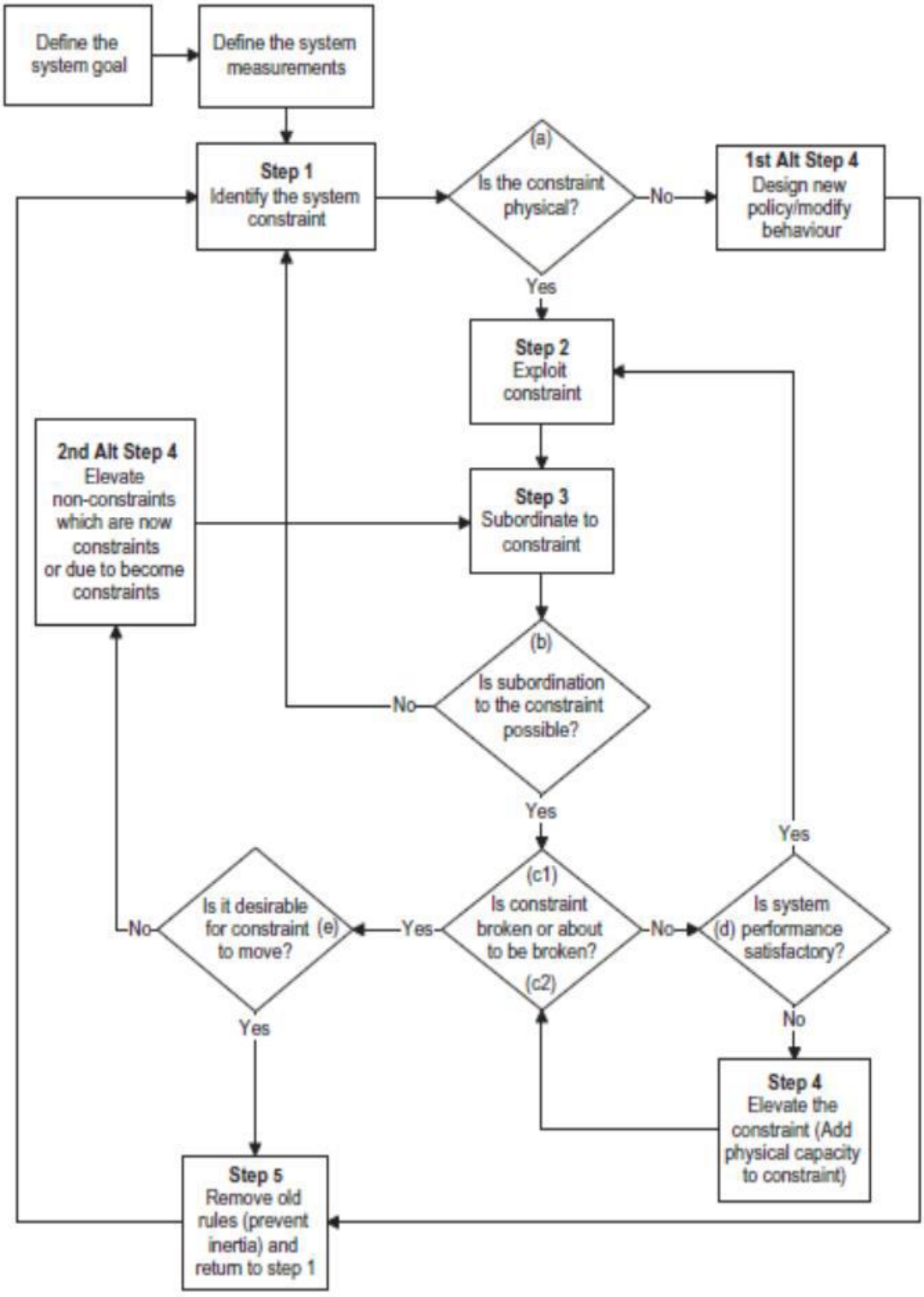

Figure 2.5. In between decision stages to the five TOC focusing step (Pretorius ,2014).

Decision point D happens if execution is agreeable which makes a type of connection between stage 2 and stage 3 (Pretorius, 2014). Step E manages the ideal constraints area also, sometimes it probably won't be alluring to pass the limitation (Pretorius, 2014). The remainder of the cycle keeps the standard TOC procedure.

2.10. DMAIC Methodology

Among various devices of quality management that might be considered as techniques for quality improvement, there are two principal ones utilized in the Six Sigma system: DMAIC and DMADV (define, measure, analyze, design, verify) (Kumar and Sosnoski, 2009; Jones, et al., 2010). DMAIC is an abbreviation from the words Define-Measure-Analyze-Improve-Control. This technique depends on interaction improvement as per the Deming cycle. The Deming Cycle, or PDCA Cycle (also known as PDSA Cycle), is a continuous quality improvement model consisting of four repetitive steps for continuous improvement: Plan, Do Check (Study), and Act. DMAIC cycle comprises of five phases which are associated with one another (Sokovic, et al., 2010; Sin, et al., 2015): Defining the objective and its necessities: characterizing required assets and obligations, characterizing organizational structure which is great to accomplish the objectives, distinguishing proof of the components and setting the assessed date of the finished task, acquiring support from the management.

The basic incentive for this stage is to make sure if the moves, which ought to be taken to tackle the issues, are associated with the needs in the association and that there is support from the management and accessibility have required assets. It

begins with recognizing the issue which needs an answer and finishes with understanding this issue just as reasonable proof of the administration oversight. There are many ways to distinguish a venture for improvement. It is smarter to zero in on outside variables, which make the expense for association and make the moves to dispense with them and after that take care of the inside costs issues. A valuable apparatus that assists with narrowing the issue can be the Pareto chart (Shankar, 2009).

Measuring the current cycle depends on the identification of substantial, dependable measurements, also by inspecting if there is sufficient information to gauge, documentation of current performance and adequacy, performing relative tests. The measuring phase concerns collecting data about procedures that will be improved. It centers on data that is needed to see all the procedures in the organization, clients' assumptions, providers' particulars, and distinguishing proof of the potential spots where an issue may happen. It could be finished by making a cycle guide of the genuine circumstance and executing failure mode and effect analysis (FMEA) which will demonstrate the spots of conceivable danger. The primary issue of the measuring stage is to gather and dissect the information which will be required in the control stage to show the distinctions and evaluate the advancement which will be introduced to the management. It is likewise fundamental to survey the measurement framework and to guarantee that all information is genuine and gathered in an appropriate manner (Shankar, 2009).

Analyzing the results is determining the reasons for measuring flaws and potential answers for them: recognizable proof of key explanations behind issues, identification of contrasts among current and expected performance, assessment of assets needed to accomplish a target, identification of potential hindrances. In the analysis stage various devices and techniques are utilized to discover underlying causes, evaluate the danger and investigate information. To affirm the investigation, a few samples ought to be analyzed and potential issues must be demonstrated to be genuine issues. In this stage, it is expected to characterize measure capacity, explain the objectives dependent on genuine information acquired in the measuring stage, and start underlying cause investigation which affects measure fluctuation. By computing measure capacity that is characterized as the "sigma" of the interaction, the capacity of the cycle to meet clients' necessity is estimated. Interaction capacity will be a central issue for expected improvements (Smętkowska and Mrugalska, 2018).

Improving interaction can be achieved by setting up a design of work division, creating and testing potential solutions, choosing the best one, planning the usage plan. The goal of this stage is to take fundamental data to make and build up an activity plan to improve the working of the organization, financial angles, and client relationship issues. The potential answers for the activity strategy ought to be introduced and performed. Some sort of pilot arrangements, affirming the legitimacy and exactness of scientific work which permits to make any amendments

prior to applying the arrangements for an enormous scale, is done (Smętkowska and Mrugalska, 2018).

Controlling the improved procedure can happen by checking the outcomes in a consistent way: documentation of the arrangement of normalization and actions observing improvements, affirmation of the improved methods, moving the responsibility for pertinent groups after the finish of the task. The control phase is about affirmation if changes executed at the improvement stage are adequate and nonstop by checking the nature of the improved procedure. It likewise controls the future condition of the interaction to limit deviation from the destinations and guarantee that the adjustment is actualized before it would have an awful impact on the outcome simultaneously. Control frameworks, for example, measurable cycle control ought to be executed. The procedure must be persistently observed. In the control stage control charts are utilized to distinguish if the cycle can be controlled or not. The Six Sigma permits actualizing logical strategies in the association to convey the best quality to the clients. There are likewise some extra advances that ought to be taken in the DMAIC process: perception of significant issues of the business and outside environment, improvement of a theory dependent on this perception, making forecasts upon speculation, testing the expectations and further perception, directing procedures and utilizing measurable strategies, rehashing the last two points and contrasting the speculation with the outcomes for perception and trials (Pyzdek, 2014).

The food service is a significant area of the world economy that faces numerous difficulties furnishing a wide scope of items with short conveyance times and requiring little time to deliver. Continuous Improvement (CI) activities could help this industry deal with its difficulties as the worldwide market perseveres through monetary and political emergencies. Lean and Six Sigma are two generally utilized and perceived CI activities and are frequently hybridized as Lean Six Sigma.

The point in the study carried out by Bonome et al., 2018, is to merge the current information concerning the use of Lean and Si Sigma (L&SSi) in the food business, investigate the L&SSi advancement in the food industry, and distinguish the pertinent parts of execution like causes of selection, basic achievement components, instruments, and techniques applied, obstructions confronted and benefits acquired.

The survey of the research recommended that L&SSi are powerful in the food business setting. Their usage in the area is as yet developing. Their utilization was found to diminish expenses and increment productivity. Human components and the food business attributes were recognized as the fundamental boundaries to executing these activities. Future examination to explore the degree that L&SSi rehearses were received in the food business and to recognize the prescribed procedures to actualize these activities is proposed.

Lately, an expanding number of organizations have utilized various sorts of quality programs to build consumer loyalty just as to diminish quality expense. Among these projects, Six Sigma is maybe the most generally acknowledged activity by each of an expansive scope of organizations. The DMAIC approach has been

followed here to take care of a basic issue of lessening measure variety and the related high deformity rate. A published paper carried out by Hung and Sung, 2011 investigated how a food organization in Taiwan can utilize an orderly and restrained way to deal with a move towards the objective of Six Sigma quality level. The DMAIC stages are used to diminish the imperfection pace of little custard buns by 70% from the baseline to the top. Toward the start of this venture, the imperfection rate was 0.45% (Baseline), and after the improvement activities were executed during a six-month time span this tumbled to underneath 0.141% (objective).

The motivation behind the paper of Idrissi and Benazzouz (2019) was to introduce the basic contrasts between two of the most remarkable systems in the food industry. The approach taken was to follow the procedure of Antony (2011) about Six Sigma versus Lean, to analyze the aftereffects of two contextual analyses done in a fish canning organization in Morocco by specialists in the field of both Lean and Six Sigma techniques. Albeit the two approaches are centered around the procedure and quality improvement, Lean is considerably more simple to utilize and permit the organization to gather the natural products without utilizing complex statistics, however, Six Sigma requires extraordinary dominance of statistical apparatuses, which is perhaps the greatest of needs by the food industry in Morocco. The paper gives an incredible asset to numerous analysts and specialists who are occupied with exploration and uses of the most two ground-breaking techniques for accomplishing and supporting operational greatness. It is additionally basic to comprehend the essential contrasts between these two philosophies.

The research carried out by (Alkun sul et al., 2018) was to study the impact of LSS components on the Jordanian Pharmaceutical Manufacturing organizations' business performance. Data were gathered from 120 administrators out of around 300 supervisors by questionnaires. In the wake of affirming ordinariness, legitimacy, and dependability of the study procedures, correlation analysis was done, and afterward, multiple regressions was utilized to test the theories. The outcomes showed that there is a concurrence on high execution of Lean Six Sigma factors among Jordanian Pharmaceutical Manufacturing associations; there are solid connections among Lean Six Sigma factors, except between non-used ability and transportation; there are solid connections between Lean Six Sigma factors and business execution. All Lean Six Sigma factors have an impact on business execution, with the exception of additional preparing and holding uptime.

This study was completed on the drug business in Jordan, summing up consequences of one industry and additionally one country to different enterprises and additionally nations might be questionable. Stretching out the examinations to different businesses and nations addresses future research openings. Applying Lean Six Sigma principles to the entire Jordanian Pharmaceutical Manufacturing industry can help them enhance their business execution; it's also being used in other manufacturing industries. The point of all associations is to decrease waste, which saves the natural assets, which is considered a corporate social obligation. Only a couple of studies identified with Lean or Six Sigma have been done in the drug industry in Jordan.

The drug business is a very huge, dynamic, and exceptionally productive industry. Pattison and Warren (2003,) recommend that in 2002 the drug business pulled in benefits that far surpass different ventures and represented benefits "five-and-a-half times more prominent than the median for all enterprises addressed in the Fortune 500". Medication discovery and improvement are expensive and the business is tormented with drug disappointments during the advancement stage. Counting the expenses of disappointments, creating and taking another medication to the market, the assessed cost for drug improvement is in the district of US$1.5 Billion and keeps on developing year on year (Gassmann, Reepmeyer & Zedtwitz, n.d.)

The business is currently confronted with discovering approaches to improve profitability while meeting item and client, regulatory, and product requests. Two issues differentiate the drug business from most different enterprises. First and foremost, buyers of drug items regularly have almost no say in the items that they use. Secondly, the drug business is one of a few enterprises in which patent assurance basically equals the item. The Six Sigma can be characterized as numerous things, and to various individuals, it might have various implications. Some will characterize Six Sigma as a philosophy that plans to deliver close to consummate production procedures. In mathematical term, the tremendous numbers of writing regarding the matter are upheld by Pande et al. (2000) who recommends that Six Sigma focuses on a performance focus of just 3.4 imperfections for every million exercises. Some will characterize Six Sigma as a change in hierarchical culture with the result to improve the position of an organization, with the objective

to accomplish more noteworthy consumer loyalty, productivity, and competitiveness. While Six Sigma is not a statistical framework, it utilizes statistics as a significant apparatus for the utilization and translation of information. Six Sigma has been utilized by a portion of the world's best organizations in a wide range of ventures as a way to expand their operational proficiency and improve quality while encouraging consistency, and giving huge advantages to the client (Jernelid and Roan, 2009).

The focal point of Six Sigma is to improve consumer loyalty and diminish cost by utilizing realities and measurable investigation to limit the non-alluring varieties in the business measures. Various organizations that have just executed Six Sigma within the drug business have been reached as a way to explore if or how the clients profit from Six Sigma. Six theories were made to explore if Six Sigma is undoubtedly a reasonable key technique for the business and if the business can use the huge experience from different organizations as an example to apply Six Sigma. Organizations are constantly contrasted, notwithstanding that they are engaged with similar industries and they will have various capabilities and competencies. Speculation was in this way made to explore if organizations should accept Six Sigma in the whole association as opposed to simply divisions only (Jernelid and Roan, 2009).

Administration and responsibility were likewise explored in the Thesis to discover how basic this is to the accomplishment of Six Sigma in the drug business. As a way to answer the speculation, various Key Performance Indicators were utilized to

gauge client benefits that comprised of; improved nature of the item, cost decrease, more limited conveyance times to advertise, and expanded monetary help for new development projects. The outcomes showed that a crucial accomplishment of Six Sigma is the help and authority of the management at each level. Organizations that have senior administration neglecting to drive and assess Six Sigma would not understand the maximum capacity of the methodology. Organizations have begun to utilize another business procedure called Lean to commend Six Sigma. Lean is a system to dispose of postponements between procedure steps, arranging these cycles so that there is basically no interference (Jernelid and Roan, 2009).

Even though Six Sigma has been so fruitful in numerous associations, the effective uses of Six Sigma are uncommon for the chemical procedures because of exceptionally nonlinear reasons. This paper which was published by (Young-Hak et al., 2003) gave an effective case to the synthetic chemical industry where corrupted quality has been improved by utilizing the proposed Six Sigma methodology. The procedure comprises of required strategies in each stage and the methods incorporate not just existing devices, for example, 5M1E methodology (abbreviation stands for "Manpower, Machine, Measurement, Material, Methods, and Environment" it is a technique where you ask questions about the 5Ms & E till you find the root cause of the problem), partial least squares (PLS), and design of experiment (DOE) yet additionally another system to find precise key wellsprings of quality debasement. This contextual investigation has been an extraordinary

achievement; from 3.5 introductory sigma to 5.5 sigma has been accomplished by applying the proposed philosophy to the quality debasement issue.

Dow Chemical's usage of the six sigma is a very much archived example of overcoming adversity. In a short course of around three years, Dow's six-sigma program has outperformed most assumptions and objectives of key and monetary execution. At present, the Dow's program has enlisted a great $1.5b reserve funds since 1999. Besides, the program has been successful in establishing a climate for positive, amazing social change that is predictable with Dow's elevated worldwide and human goals. In a paper published by Kumar and Antony, (2004), At the Dow Chemicals Company, a business interaction change system was used to investigate the variables that aided or hindered the fulfillment of six-sigma quality goals. The information for this study was acquired through meetings, poll overview, and documented sources. This work is relied upon to fill in as a reason for assessing the idea of the effect that six sigma execution practices would have on an association's success.

Indonesia's chemical industry is confronted with the test of expanding its supply chain performance, while the chemical business in Indonesia for the most part actually does not have a system to measure performance in its supply chain. The target of the study carried out by Hasibuan and Dzikrillah, (2018), is to build up the system of supply chain performance measurement of the chemical business utilizing SCOR “(The supply chain operations reference (SCOR) model helps businesses evaluate and perfect supply chain management for reliability, consistency, and

efficiency)" and DMAIC models. The exploration stages are the choice of chemical industry supply chain markers, benchmarking of markers, advancement of the structure for supply chain execution estimation for Indonesia's chemical industry, and the improvement of the supply chain execution.

The execution was done at the cases in the market chief organization which produces material (textile) dyes items in Indonesia. The aftereffect of experts' agreement suggests 28 markers of the modern chemical industry supply chain. The top tier for each production network execution marker becomes the presentation focus on the performance measurement system which is created. The consequences of estimating the presence of the chemical business supply chain in the material colors item showed great execution at adaptability angle, medium at cost, dependability, and resource management cost, and low at responsiveness perspective. There were three critical to quality (CTQ) for responsiveness angles; these are request study, crude material issue, and malfunctioning of machines. The prescribed recommendations and improvements are to give training on-demand investigation, to improve correspondence with the local party, to furnish different merchants, crude material planning, acquisition of cushion stock for crude material, and scheduling of preventive support and maintenance.

2.11. Integrating of Six Sigma and TOC

A research carried out by Pacheco, (2014) investigated significant factors about TOC and Six Sigma when utilized for the continuous improvement (CI) of cycles in manufacturing frameworks. The research additionally added to a superior

comprehension of the major standards of such techniques by playing out an analysis comparing some angles viewed as basics. After the investigations, it was discovered that analyzing the purposes of combination and rejection between the two methodologies adds to a superior comprehension of its crucial standards. Generally speaking, it was found that there are a larger number of focuses that overlap between the two methodologies and that it is reasonable to consider developing an incorporated persistent improvement measure that upgrades competitiveness among companies.

However, basic variables should be considered in building models coordinating the two methodologies, without which the improvement of an incorporated model gets feeble. Among the principle, basic components are that the literature actually doesn't have a reasonable definition on such viewpoints just as territories for promising circumstances for analysts: How to pick the right components of each approach as per the genuine necessities of the association? How could the organization unequivocally characterize its need, to decrease fluctuation or on the other hand to lessen misfortunes and improve flow, or to eliminate constraints? The right determination on the way of life, objectives, qualities, and shortcomings of the association ought to likewise be viewed as a part of the integration of the methodologies. Another basic factor to be considered is the breaking of helpful mental models, yet how to drive and make possible of this change? For instance, the non-compelling commitment of administrators is an attribute of the social execution of the TOC and Six Sigma; the standards of the development of a model joining

such methodologies should fundamentally be lined up with the organization's methodology and objectives (Pacheco, 2014).

The results of this investigation showed that the TOC and Six Sigma have reciprocal angles that overlap the purposes of rejection and that there is a vast area for research on the subject. To propel way of thinking that gives in-depth comprehension of the interrelationships between approaches or assess. the commitments of different methodologies. The accompanying exploration points additionally arise for future examination plans: What markers ought to be utilized to quantify a performance model coordinating the two methodologies and how could we structure them (which levels) in the association? How might we pick what will be the predominant culture of the organization and how could we construct it, accepting that the methodologies exist together? (Pacheco, 2014).

Nave, (2002) reported that Six Sigma, TOC and Lean Manufacturing, regularly appear to be in clash with one another, making disarray between their disparities, impacts, and likenesses (Nave, 2002). Consequently, the theories were compared to one another.

The customary way to enhance the manufacturing interaction is an added substance approach which essentially focuses on every complication because it is distinguished in the production cycle and afterward expects to address these complications (Woeppel, 2015). Woeppel, (2015) reported that the framework's approach plans to recognize an alleged "influence point" simultaneously. However, not every odd complication that is distinguished and rectified will enhance the

framework in general, one needs to adopt an engagement strategy to distinguish the influence step that will enhance the framework in general (Woeppel, 2015).

The issue with the customary methodology is that supervisors become disappointed with the constant activities and after a period will in general quit supporting the undertakings, as a significant number of these ventures don't accomplish their normal results (Woeppel, 2015). A large number of these activities don't improve generally speaking organization performance, which additionally will, in general, diminish the help for the enhancement functions (Woeppel, 2015). As indicated by Cook (1994), every improvement philosophy, regardless of whether it is Lean Manufacturing or TOC, requires control and cannot each one of them be viewed as the answer for all challenges.

Taking everything into account, TOC centers around limitations and limitations in the framework, Lean spotlights on production course and Six Sigma is complication-centered (Nave, 2002). Nave's reasoning is defective anyway as he expresses that improvement system selection ought to be directed the way it is assessed, not what is important for the organization or what the client needs.

Ras and Visser (2015) expressed that over 70% of Lean Manufacturing, Six Sigma, and TOC are fruitful yet associations would in any case invite a consolidated methodology. Mclean, et al., (2017) expressed interestingly that persistent improvement activities have a high disappointment rate. The fundamental reasons nonstop improvement programs fizzle as indicated by Woeppel (2015), is because of constant enhancement groups supporting device appropriation and not

accomplishing business objectives, cost reserve funds not being calculated, and helpless spotlight on what should be utilized.

A blend of cycle improvement procedures will guide to the creation of better quality yields, a diminishing in stockpile, increment in benefits, and an enhancement force to be reckoned with (Creasy, 2014; Stamm et al.,2009; Nave, 2002). As per Creasy, (2014), 30% of associations have actualized a mix of progress systems and practices which focus on the requirement for an incorporated structure.

Service is the central figure in the hotel business and its importance in the achievement of the hospitality area cannot be underlined enough (Wilkins et al., 2007). It is in the idea of the hotel business to persistently improve and upgrade the nature of services for business achievement. Getting the Six Sigma system in a cycle is viewed as an image of quality (Wilkins et al., 2007) and is appealing to most associations for the advantages it gives. Monier-Vinard and Grant (2014) revealed that advantages coming about because of getting Six Sigma in the banking industry to enhance money management demonstrated a decrease of mistakes, fewer postponements, fewer protests, diminished operational danger, a decrease of modification, and duplication of work, and a 13% efficiency improvement. The United States military utilized a Six Sigma approach in item improvement to effectively plan the cutting edge helicopter, saving them billions of dollars (Fulton, Bastian, and Wilson, 2015).

Numerous associations in plenty of business territories, plus those for the hospitality business, are attracted to the development and oddity of Six Sigma as an

improvement instrument for a wide range of issues, though in all actuality this is not the situation. This may happen when organizations utilize Six Sigma system just to stay aware of the opposition, or to intrigue investors by having the option to utilize consistent interaction improvement phrasing in organization documentation. Associations that convey Six Sigma as a restorative change, or actualize it without the assets it requires, are welcoming disappointment (Wilkins et al., 2007). Another methodology that is like Six Sigma system is the making of Lean cycles to dispose of waste and increment incentive and quality to the client. At present, Six Sigma and Lean Management systems are the most generally perceived continuous improvement (CI) activities accessible to associations (Alsmadi and Khan, 2010) with comparable difficulties. Questions emerge around whether these two methodologies should be actualized in equal or whether they ought to be coordinated. These approaches become more testing in the hospitality and hotel industry than the manufacturing industry because of the attributes of elusiveness, destruction, diversification, synchronization of creation, and utilization of the procedures in the hospitality industry (Reisinger, 2001; Reid and Bojanic, 2009).

In the 1990s, Xerox Company switched the Lean Production System as a Lean technique and actualized it in their inventory management network. In 2002, Xerox coordinated Lean and Six Sigma techniques together and named it "Lean Six Sigma (LSS)". The primary purpose behind this incorporation was to enhance the quality production measures by abolishing mistakes and decreasing expenses. With the Xerox Corporation prevailing with regards to actualizing the LSS technique in their

production cycle, numerous medical care associations began to embrace this way to deal with improving their quality toward patient fulfillment (Ahmed et al., 2018, Salah and Rahim, 2019). Also, a combination of Lean and Six Sigma systems can enhance the quality exhibition of the medical care association by expanding patient consideration toward fulfillment and reliability. The LSS technique guarantees quality execution of the medical services association by lessening errors in the clinical trial report, holding up time, costs and conveying test reports (Antony et al., 2018, Trzeciak, 2018). As per De Koning et al. (2006), the LSS strategy strongly affects creating inventive wellbeing administration by lessening expenses and mistakes, for example, the radiology branch of Virtua Health diminished drug and research facility blunders and enhanced patient security and safety by executing the LSS system. Also, the Commonwealth Health Corporation applied the LSS system in the task of the infectious diseases control division and they prevailed in lessening the disease rate by more than 65% in a couple of years. The LSS approach decreases waste and expenses as well as sets up a disciplined and understanding way of consistent quality improvement in a medical services association to guarantee precise results in a convenient design (Neufeld et al., 2013).

An investigation carried out by Ahmed (2019) gives needful data to characterize both methodologies (DMAIC and TOC). It gives the suitable rules on the most proficient method to dissect a medical care framework by incorporating DMAIC and TOC approaches toward quality execution. To be on the safe side, the medical care association needs to acquire the responsibility and contribution of experts for

effectively executing the DMAIC phases and TOC versions. The execution of these two methodologies would help the medical care association to break down medical care execution, for example, understanding the safety of the patient, monetary results, persistent fulfillment, and allegiance (Bauer et al., 2016, Gupta et al., 2019).

Also, from an essential perspective, the joining of the DMAIC LSS strategy and TOC system connects the internal and external services and performance of the medical care association. This mix does not just give experiences to experts concerning the diagram of the DMAIC and TOC for the consistent improvement of medical care quality execution, in addition, makes an extraordinary competency that might be hard for contenders to copy. Fundamentally, the top administration of the medical care organizations ought to invest energy to comprehend both of the applications and join these models under the management supervision for continuous improvement (CI). At this point when it is done appropriately, the two methodologies can expand the estimation of the medical care services by improving quality execution (Ahmed, 2019).

A study carried out by (Al Amin et al., 2017) which dealt with the fruitful usage of Theory of Constraint in relieving the bottleneck. Bottleneck can inhibit high profitability and minor profit. Simultaneously bottleneck oversees abundance of stockpiles and deferrals of on-time conveyance. The researchers have utilized the strategy of Theory of Constraint (TOC) which was trying to adapt to the constriction. Yet, Drum-Buffer-Rope planning has encouraged the system more readily and has improved the framework with overseeing inventory and diminishing

activity time. In the wake of executing TOC all out, throughput was expanded 34.42% each month that resulted in a 35.59% increment in benefit and a 0.3% increment consequently on funds invested each month. Therefore, three principal focal points were created: a) Acceptable degree of On-Time Delivery b) Space accessibility in the store just as the production area and c) Quality of item because of better management over activity of limited sources. The best time of non-constraint means is used by different motivations behind improvement work.

As has appeared, TOC acts preventively and adequately, by controlling the impacts also, wiping out the reasons for limitations, without influencing the flow, by utilizing the existing ability to supply orders of customers. TOC theory is viable with businesses and retailers since it deals with the bottlenecks that influence the production flow, subjecting the wide range of various exercises to the imperatives and guaranteeing an increment in quality added. TOC is particularly valuable for assisting businesses with diminishing their lead times and inventory levels. In light of studies among firms that utilizes TOC theory and the outcomes acquired at Rodrinex (a small-sized company that deals with car spare parts in the city of Campo Limpo Paulista (Sao Paulo), one can reason that clients of TOC theory report decreases the lead times of their procedures by 30 to 45%, and diminishes their inventory levels in the range of 50 and 75%. This framework likewise brings about more noteworthy adaptability of the production framework through maximizing the manufacturing blend and expanding the benefit by over 400%.

A study carried out by Lacerda, et al., (2007) showed how Process Engineering can be used to add to the Process of Thinking of the Theory of Constraints in an educational organization. Utilizing the ideas and procedures of the Engineering Process it was conceivable to arrange the Theory of Constraints approach for a few sections and procedures in the organization. The Process Engineering empowers, through the proposed approach, the discussion through the analysis of the authoritative dangerous beginning from the displayed measures. During the displaying measures stage, other than the portrayal of the actual exercises, it was confirmed a bunch of insights that make more extravagant the development of the Current Reality Tree. Another significant factor of the commitment of Engineering Process is that it empowers the beginning stage for the development of the trees. In the hypothetical ideas of the Theory of the Constraints, there are no characteristics of how to begin to assemble the Current Reality Tree.

Directors should zero in on successfully dealing with the constraints and ability of these limitations if they are to enhance the exhibition of their association. TOC has expansive applications in different organizational settings. TOC provokes directors to reexamine a portion of their major presumptions about how to accomplish the objectives of their associations, about what they think about fruitful activities, and about the genuine motivation behind management control of expenses (Tabish et al., 2015). When the limitations are distinguished, TOC transfers all the non-constraining assets of the association to the requirements of its center constraints. The outcome is an advancement of the absolute arrangement of assets. TOC is

fundamental to upgrade the quality of clients and institutional productivity. TOC addresses a colossal change in management, distinction, and direction of the organization. It is progress molded by a few major ideas that can be utilized to construct a productive establishment for any association (Tabish et al., 2015). These ideas include:

• A new system to consider.

• An interaction of nonstop improvement cycles.

• A principal choice interaction zeroing in on worldwide as opposed to nearby issues.

• Another technique for breaking down the connections among assets and measures and discovering where to center the organization's endeavors.

• New strategies for dissecting strategy issues to reach easier arrangements.

• Another management approach for giving the key and strategic course.

The TOC is an administration advancement that negates the customary way of thinking with advantages of quicker administrations, more prominent adaptability, and a reasonable re-rearranging of the management needs for product development and profitability. TOC approach is an ideal supplement to other improvement systems, for example, Total Quality Management and Business Process Reengineering. It centers on improvement endeavors where they are probably going to be best. Zeroing in your work on the most fragile connection will bring the greatest advantage. Distinguish the most fragile connection, which is the constraint.

The TOC is a bunch of comprehensive cycles and bits of knowledge, all dependent on a framework approach that streamlines the improving and overseeing of complex associations by zeroing in on a couple of physical and consistent compelling influence points. It gives an apparatus set to construct and actualize the beliefs (encompassing standards) that synchronize the parts to accomplish a significant degree of improvement in the exhibition of the whole system. Rich in idea and plan, TOC concentrates on the variables that block framework execution. TOC is the lone steady way to deal with measure improvement (Tabish et al., 2015).

A large part of the issue in current medical services has to do with the compelling and progressive acts of the organization. Fruitful improvers are skilled at characterizing the issue or opportunity supportively. Theory of Constraints offers a route forward, a philosophy that is conveying exceptional discoveries in the quality and idealness of care and monetary execution. It is likewise ending up being a strategy that specialist doctors, nursing staff, and chiefs of divisions would all be able to embrace in a medical organization (Tabish, et al., 2015).

In a research done by Pesic, et al., (2013), they suggested that today, when various items imported from foreign companies are available in Serbia, homegrown organizations should guide their focus toward seriousness, in order to compete and carry the cost of transition. This exertion for most organizations in Serbia normally identifies with cost decrease. Specifically, decreasing expenses per unit, with the remark that cost decreases lead to higher profits. The spotlight should not be on the expense but on product quality and value. If an organization, to decrease costs per

unit, centers on expanding production volume, without considering the requirements of shoppers, throughput, and constraints, it will confront the antagonistic impact, definitely, the increment of expenses, which will endanger a definitive objective, which is making cash. When an organization deals with throughput and constraints in the organization of production, albeit the essential goal does not cost decrease, it will arise as one of the ideal impacts.

Intending to add to the information on outbound plans, the study carried out by Bernardi, et al., (2008) introduced TOC distribution philosophy, examining the presuppositions on which it is based, just as its primary qualities. It should be clarified that a large number of these qualities are explicit to TOC technique, for example, the concentration in improving Supply Chain (SC) throughput overall, Dynamic Buffer Management (DBM) strategy, and the utilization of measures. Perhaps one of the principal commitments brought by TOC is its throughput direction. TOC centers basically around the throughput increment, despite the fact that venture measures with SC – and related expenses – and cross shipment costs might be altogether diminished with the proposition.

Numerous strategies related to this philosophy attempt to arrive at higher throughput levels. A purpose behind this is that, because of challenges in estimating real lack of products levels (the customers don't generally whine about the absence of an item, and when they do, the SC data information system is not managing these data appropriately, the genuine volume of missed deals is a lot bigger than envisioned. Because of regular methods of inventory management along with SC,

retail stores work with shortage levels of 20%. Kendall (2005),) and Schragenheim (200) noticed a few different methods of expanding throughput, among them the decrease of shortage rate.

The scope of utilization of TOC incorporates assorted territories, for example, Management of Projects (through Critical Chain Project Management), Distribution and Supply Chain (through Management of buffers), Production (through Drum-Buffer-Rope), Sales and Buy-In (through Layers of opposition), Strategy and Tactics, Education area (Thinking measure instruments), and Finance and Measurements (through throughput bookkeeping). TOC has been applied in incorporation with Activity Based Costing (ABC), linear programming, TQM, Enterprise Resource Planning, and Lean. TOC application covers the useful fields of advertising, human resources management, and item management, servicing management (for example restaurants, healthcare organizations, E-trading, innovations management, Entrepreneurship, Aviation, and Banking). Indeed, the extent of utilization of TOC is developing quickly as of now (Singh and Misra, 2018).

A few studies compared TOC, linear programming, and different techniques in a manufacturing climate, and studies zeroed in on the ideal item blend by objective programming and featuring the shortcomings of TOC in various bottleneck issues. The ABC asset utilization investigation ought to be changed over into an asset supply. Management consideration ought to be on bottlenecks convenience by

utilizing TOC to distinguish the ideal transient blend of items that can be produced (Singh and Misra, 2018).

A study carried out by (Ferencíková, 2012) was centered on the job of data and information technology in improving the dynamic in TOC projects in a manufacturing climate. An insightful item cost approach has been supported by researchers for choosing to erase a product offering, to have an improvement in arrangement time, to make the market for separated items, and to use information base, correspondence measure, management assets for A Process of Ongoing Improvement (POOGI) in a TOC climate.

The combination of TOC and ABC functions admirably in a manufacturing climate (Kershaw, 2000; Kee, 1995). TOC approach is relatively simpler, takes less information and managerial endeavors than ABC. In any case, coordination of TOC, TQM, and consistent improvement standards is not suggested for these methodologies for not supplementing one another (Holmes, 2005).

In an increasingly serious and globalized climate, it gets imperative for ventures to build a Logistics Management lined up with the system of the organization. A middle size international Italian company, related to home appliances line (Siber do Brasil S.A.,), in the same way as other different organizations in its industrial part, expected to divert their management procedures breaking its long time standing in the world, and actualized new management ways of thinking that made it conceivable to divert the organization objectives toward profitability and their essential targets. In that specific circumstance, three immediate models show up:

TOC - assures that worldwide upgrades and improvements should prevail over local ones by the emphasis on the framework constraint, and keep up absolute thoughtfulness regarding the production of the organization in disadvantage of the action costs; Vendor Managed Inventory (VMI) - that proposes to move the client's stock control to the provider without a deficiency of client's authority over the responsibility for products; and Business to Business (B2B) - that gives quick and powerful correspondence among associations and individuals (Santos et al., 2010).

In a presentation at a conference by the TOC International Certification Organization, Machado (2011) explained some information about a company named Agentrics. Agentrics is a worldwide supplier of business answers for the market supply chain. Agentrics was established by the world's top retailers to help increment their serious edge and profitability through the joint advancement of best business processes. Today, Agentrics offers arrangements covering spend the board, sourcing, supply chain management and restocking, online joint effort, and correspondence just as private item improvement and lifecycle management.

In a research carried out by (DEMİREL UTKU, CENGİZ & ERSOY, 2011), results showed that the explanation of the profits procured by the item blend decided with the throughput approach is more profitable than the benefits acquired by the customary techniques (full and changing costing strategies). This discovery upholds the past writings by Lee and Plenert, (1996), and (Atwater and Gagne, 1997). Previous research contends that the conventional expense accounting strategies create shallow end result expenses and trait unreasonable expenses to the production

measures since TOC thinks about just the variable expense as immediate material. There is an agreement that the TOC production approach creates a more genuine item cost as it reflects just direct expenses to the item cost. The more real item cost data that the throughput approach creates, will give more exact transient production measures and will aid choices like evaluating prices and venture.

The use of the 5-whys examination in the manufacturing industry (XYZ Corporation) offers a fact-based and organized way to deal with issue recognizable proof and remedy that only diminishes, yet additionally absolutely kills errors. Restorative activity has forever killed the peak error, which is the "last piece material scratch" and this helps in zero scratches from thereon. In this study (Murugiah, et al., 2010), it was likewise demonstrated that with a sound comprehension of manufacturing combined with potential arrangements utilizing the 5-whys investigation the writers were ready to kill waste, yet additionally to do it with zero cost.

A paper published by (Bom et al., 2019) which talked about the connection between sustainability and the cosmetics industry, the components animating the advancements in this field, the need to evaluate those, and the accessible devices, close by with the supportability impacts created during all the products life cycle. The results uncovered cosmetics sustainability as an intricate and multifaceted issue that cannot be assessed thinking about single perspectives, however utilizing a coordinated appraisal about the natural, social and affordable measurements and about the end result quality and performance. Here comes the role of TOC that can

enhance the profitability by decreasing waste, or combined with other management systems.

Public medical care suppliers normally battle with the need to satisfy the need for services, with a restricted financial plan. (Mabin et al., 2018), published a paper which had depicted a study of a huge public hospital, utilizing the Theory of Constraints (TOC) complete arrangement of planning devices to intelligently address dangerous constraints and explore choices to resolve these constraints. In light of the manifestations present, main causes and clashes were recognized, alongside resolutions. Further TOC instruments were utilized to check for conceivable results of the arrangement and recognize hindrances that may hinder effective usage. In view of the TOC investigation, a preliminary undertaking was actualized with huge advantages for two divisions. Results included significantly diminished patient standby and waiting time and staff extra time, expanded patient fulfillment, expanded efficiencies, smoothed responsibility, and improved staff confidence and morale, while keeping up patient security and uprightness of treatment, and remaining within characterized cost boundaries.

Indian pharmaceutical organizations burn 33% of their income from Supply Chain Management (SCM) exercises because of the innately helpless transportation framework. SCM is a fundamental capacity for some organizations, as it is typically utilized to bring down costs and increment deals by the organization. SCM costs are higher in India than they are in different regions of the world, adding up to 13% of India's GDP. The motivation behind this study (Boleneni, 2016) was to investigate

SCM techniques that Indian business pioneers in the drug business have used to lessen the significant expenses related to SCM. The study utilized a solitary contextual analysis research plan and informal meetings to gather information from 3 SCM working explorers working in Indian pharmaceutical organizations and having effective involvement with utilizing SCM systems to diminish significant expenses. Goldratt's (1990) TOC was utilized as the reasonable structure for this investigation to recognize difficulties related to SCM systems. Information from informal meetings, monitoring, and company documents was handled and broke down utilizing information source triangulation, gathering the crude information into key subjects. The accompanying 3 topics arose: circulation and co-ordinations challenges, the effect of SCM cycles, and best practices and explanations. The ramifications for positive social change incorporate the possibility to decrease store network hazard, which could prompt lower item costs for customers, expanded partner fulfillment, and a better quality of living.

Manufacturing enterprises occupied with making of moment noodles in Medan city (France) have issues underway arranging. The limitations looked at by the organization are the presence of bottlenecks on blending and cooking work stations because of contrasts in capability between the work station and the past work station, in particular, the sieving work station and batter shaping work station. Bottleneck workstations occur in blending work stations in January, February, March, May, June, July, and August 2014 just as cooking work stations in January, May, and July 2014. This investigation utilizes the guidelines of continuous

improvement of Theory of Constraints (TOC) to take out limitations on bottleneck work stations and to encourage the general production flow. In applying TOC, to advance the production main timetable and to realize the greatest bit of leeway cost, a linear programming technique is utilized. After the ideal main timetable outcomes are known, modifications of capabilities planning are done and the outcome shows that the bottleneck work station found has become a non-bottleneck work station (Siregar, 2019).

The motivation behind the exploration of the study carried out by Oglethorpe and Heron, 2013, is to recognize the perceptible operational and supply chain boundaries and constraints that happen in nearby food supply chains, particularly with more modest makers, as they look to build market entrance across a more extensive geographic region.

The exploration receives numerous contextual investigation approach utilizing blended strategies for information assortment where contextual investigation organizations are met and complete a survey. This interaction permits making a store network plan and makes an account that records the weights and effects happening in nearby food supply chains and more modest makers looking past neighborhood retail stores. This proof is then set against the Theory of Constraints (TOC) to give hypothetical support and to inspect the consistency of the discoveries.

Seven general classifications of constraints types are noticed: constraints because of the character of the market; because of scale and the nature of items; constraints identified with business and abilities; organizational limitations; limitations in-store

network connections; certification, strategy, and administrative constraints; and constraints around personal convictions and humanoid attribution. Each is depicted with regards to its inception, its constraint to business, and where conceivable, how it very well may be resolved. Recommendations for development are put forth through communitarian producer attempts, elective institutional interfering, supply chain re-designing, and logistics improvement (Oglethorpe and Heron, 2013).

Recommendations are made to improve the comprehensiveness of supply chain organizations, to likely use territorial food groups, to create opportunities to set up independent inventory network centers and to expand the capacity of farmer co-operatives. The study additionally gives an unconventional model of the TOC explicitly adjusted for local food makers, the focal point of which takes advantage of their natural abilities and spotlights on building capabilities across, all over the supply chain (Oglethorpe and Heron, 2013).

TOC strategies have been talked about in the scholastic writing, including Supply chain management (Rahman, 2002; Watson and Polito, 2003; Simatupang et al., 2004), management of projects (Goldratt, 1997; Leach, 1999; Cohen et al., 2004), retail stores (Goldratt, 1994), measures improvement (Ronen, 2006; Atwater and Chakravorty, 1995), and in an assortment of production conditions (Raban and Nagel, 1991).

There are numerous reports of effective TOC executions principally from assembling associations, particularly in the aviation, clothing, cars, software, steel, semiconductor, furniture, and heavy designing areas (Mabin and Balderstone,

2003). TOC has additionally been actualized in different non-manufacturing enterprises, including monetary foundations, software, and hardware programming (Ioannou and Papadoyiannis, 2004), healthcare organizations (Ronen et al. 2006), the public institutes (Shoemaker and Reid, 2005), and education (Goldratt and Weiss, 2005). TOC strategies have been put in at various Fortune 500 organizations; 3M, Amazon, Boeing, Delta Airlines, Ford Motor Company, General Electric, General Motors, and Lucent Technologies have freely uncovered huge enhancements accomplished through the utilization of TOC systems. Furthermore, various embracing organizations express a reluctance to reveal enhancements for serious and aggressive causes. Use of TOC is not restricted to for-profit organizations; not-revenue driven associations and government offices, for example, Habitat for Humanity, Pretoria Academic Hospital, British National Health Service, United Nations, NASA, United States Department of Defense (Air Force, Marine Corps, and Navy), and the Israeli Air Force all have effectively utilized TOC systems (Watson, et. al. 2007).

Numerous studies have explored the combination of different Continuous Improvement (CI) methods, for example, TOC and just in time (JIT) (Cook, 1994; Rahman, 1998), TOC and Total Quality Management (TQM) (Lepore and Cohen, 1999; Ronen and Pass, 1994), and TOC and reengineering (Libby, 1994). In a study carried out by Ehie and Sheu (2005), they suggested an incorporated TOC/Six Sigma structure and applied this system to a shaft producing organization to enhance its best and complete activity. Under this system, TOC sketched out the course of

progress thinking about framework constraints and throughput. The aftereffects of the contextual investigation show that the organization profited enormously from its accentuation on worldwide improvement guided by the TOC idea. Directors had the option to choose a CI project that greatly affected main concern execution. SS has given different measurable devices and designing methods, (for example, value examination, Pareto outline, and control graphs) for characterizing the particular cycle to be enhanced, breaking down the underlying causes, and planning activities for making improvement. After the execution of the change, the TOC/SS system guaranteed the new change was upheld and validated by appropriate worker training and ceaseless monitoring. Correspondence for getting purchases in was made to decrease protection from changes from representatives. At last, the gear cutting undertaking improved consumer loyalty, expanded production, and nature of the cutting activity, and decreased the stock level of cutting blades.

TOC is a finished change in perspective from conventional management systems. In the first place, the timetable should be carried out in a completely new manner, drum-buffer rope, which requires a few workstations to be inactive on occasion. Second, the control system inside the shop should be changed from individual due dates at work stations to buffer management. Third, execution estimates should be changed from effectiveness-based measures to throughput dollar days and stock dollar days. At last, there should be a gigantic measure of training all through the whole association so everybody comprehends the idea of TOC and why it is

essential. As a result of the breadth of the required change, more modest associations have had more achievements in embracing TOC than have bigger ones.

Chapter Three: Methodology

3.1. Research Methodology:

This chapter discussed the research design, population, and sample size, as well as collecting data method, questionnaire design, content, and data processing and analysis.

3.2. Research Strategy

A quantitative survey methodology was employed as the major strategy to study the research questions and hypotheses.

3.3. Research Period

Work on the research began in Jan 2021, when the research topic was approved, the literature was reviewed in February 2021, writing, arbitration, and examining the questionnaire in April 2021, collecting the necessary information from mid to the end of May 2021, ending with analyzing the collected data and writing the final results and recommendations in June 2021.

3.4. Methodological Framework

The framework of the study consists of:

I. Defining the research topic and scope.

II. Reviewing the related literature.

III. Developing, judging, and using the survey.

IV. Statistically test the collected data and writing the findings.

V. Conclusion and recommendations.

3.4.1. Conceptual Framework

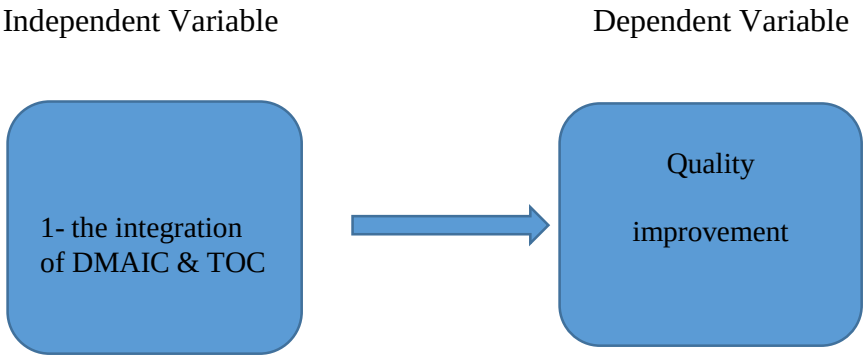

Figure 3.1: The integration of DMAIC methodology and TOC toward quality improvement

From this conceptual framework, the researcher wanted to ascertain the impact of the independent variables (The integration of DMAIC Methodology with TOC) on the dependent variable (quality improvement).

3.5. Design of The Study

Both qualitative and quantitative data collection techniques and analysis procedures were used to conduct this research, quantitative method was used when the data were collected through questionnaire, the qualitative approach was used to understand the relationship between the questionnaire variables.

3.6. Research Location

The study was carried out on factories operating in the cosmetics sector in the West Bank, Palestine that obtained a license from the Palestinian Ministry of Health, meaning that they fulfill the license conditions. Diversity exist among the factories with regard to the possess of quality certificate, and factories that do not have quality certificates but are already working according to a specified internal system that guarantees the quality of the outputs.

3.7. Research Population, Sample, And Sampling Procedure

Since the cosmetics manufacturing sector is micro in the Palestinian economy, and it can be included in the study, the entire population was studied and there was no sampling in this study.

The researcher communicated and visited the targeted factories and conducted interviews with department heads, quality and production managers, and general managers, as they are the target group in the study. One hundred and ten (110) questionnaires were filled out, all of which fulfilled the requirements for accepting the questionnaire and including it in the study.

3.8. Instruments of The Study

The researcher employed two tools in this study, the first and main tool is the questionnaire that was designed to cover the variables of this study, secondly, the interviews that were conducted when visiting factories to ensure a broader

understanding of the questionnaire variables to ensure the reliability of the data collected.

3.8.1. Questionnaire Design

The questionnaire comprises of four sections as follows:

3.8.1.1. First Section: Demographic Data

This section contains the basic needed demographic data which are: gender, age, academic qualification, job title, years of experience, and whether the company has a quality certificate or not.

3.8.1.2. Second Section: Applying The DMAIC Methodology In The Factories Understudy

The DMAIC methodology is a tool in Lean Six Sigma for continuous improvement of operations and is based on five basic concepts (define, measure, analyze, improve, and control). Accordingly, the second section was divided into five sub-sections as follows:

3.8.1.2.1. Define Phase: which contains seven questions that aim to identify and define the problems faced by the organization.

3.8.1.2.2. Measure phase: contains six questions aimed at identifying the defect and collecting basic data related to the performance of the process, setting goals for improvement, and ensuring the existence of an appropriate system for measurements in the organization.

3.8.1.2.3. Analyze phase: It contains seven questions whose purpose is to identify the data of the process, or the inputs, that have the greatest impact on the outcome of the process (outputs).

3.8.1.2.4. Improve phase: The main objective in this phase was identifying opportunities for improvement, supported by information on how these improvements help achieve the objectives of the improvement process. This sub-section contains eight questions.

3.8.1.2.5. Control phase: To implement the selected solutions and ensure that they are rooted in the improvement process. The extent of the previous application was asked through eight questions.

3.8.1.3. Third Section: Applying The Theory of Constraints

The theory of constraints is a scientific approach to improvement. It assumes that any complex system, including business processes, consists of several activities that are linked together. One of these elements acts as a constraint for the entire system (i.e. the constraint activity is the "weakest link in the chain"). TOC provides a highly focused approach to achieve rapid improvements and identify the goals of the organization, and the factors that hinder the achievement of those goals, by trying to mitigate or reduce the identified factors. It was implemented in six stages as follows: setting a measurable goal, determining the constraints, taking advantage of the constraint, improving the constraint and its related activities, increasing the efficiency and capacity of the constraint, and finally searching for another constraint and repeating the process as a whole.

Based on the foregoing, companies were asked about the extent to which the theory of constraints is applied by answering fifteen specialized questions.

3.8.1.4. Fourth Section: Integrating DMAIC Methodology and TOC

The extent to which companies integrate the DMAIC methodology and the theory of constraints in improving quality in the organizations, that consist of six questions.

The answers of the paragraphs of the three sections were according to a five-point Likert scale, as shown in Table 3.1 below.

Table3.1: five-point Likert scale

Range	Descrpition of Range
1.00-1.81	Very Weak Degree
1.80-2.60	Weak Degree
2.60-3.40	Moderate Degree
3.40-4.20	Big Degree
4.21-5.00	Very Big Degree

3.8.2. Data Collection Method and Procedures

Two methods were used to collect the necessary data for the research, as the primary data was collected through the questionnaire that was distributed and followed up on its filling through interviews with the factories that were previously identified, the interviews were conducted twice with each targeted factory, one before filling the questionnaire and the second interviews after identifying the targeted factories and the related person to contact with, while the secondary data was collected by

reading, reviewing and analyzing previous studies related and close to the subject of the study.

3.8.3. Data Analysis Technique

To achieve the objectives of the study and analyze the collected data, the researcher used several appropriate statistical tools using the Statistical Package for Social Science (SPSS) version 21.0.

First of all, the accuracy of data entry was checked in what is statistically called "cleanliness of the entered data" by finding out data frequencies which showed that the data was correctly and accurately entered.

Percentages and frequencies were used to describe the demographic data by using descriptive statics. The Pearson Correlation coefficient, mean, STD, and ANOVA was then used to determine the association between the variables. The strength of the relationship was determined by looking at the value of "r" in the Pearson Correlation (see Table 3.2) while using Pearson Correlation to analyze the data. The strength of the relationship or the degree of association between two variables is normally indicated by the sign of the correlation coefficient. The correlation coefficient, on the other hand, will be zero if there is no relationship.

Table 3.2: Pearson Correlation table

Value of (r)	Strength of relationship between variables
0.00-0.20	Very low or no relationship
0.20-0.40	Low relationship

0.40-0.60	Moderate relationship
0.60-0.80	High relationship
0.80-1.00	Very high relationship

(Obilor, et.al, 2018)

3.8.4 Validity of Questionnaire

The validity of the questionnaire means making sure that it will measure what it was prepared to measure and if the questionnaire included all the elements that must be included in the analysis, and the clarity of its paragraphs so that it is understood by everyone who uses it.

I. Judging the tool: The researcher verified the validity of the questionnaire as follows:

The questionnaire was presented to a group of arbitrators, consisting of six faculty members at the Arab American University, An-Najah National University, Al-Quds Open University, and Al-Quds university specialists in quality, industrial engineering, and the Arabic language. some modifications were suggested and the questionnaire in its final form attached to the thesis appendix (2).

II. Criterion Test: The stability of the tool was achieved by conducting the internal consistency test and extracting the stability coefficient (Cronbach alpha) on the entire sample of the study, where the stability coefficient of the tool (76.9%) was a good stability factor in social science researches, the internal consistency test results were included in appendix (3)

III. Structure Validity of the Questionnaire:

It calculates the correlation coefficient between a single field and all other fields in a questionnaire with the same Likert scale level. The correlation coefficient for each field and the entire questionnaires is shown in appendix (3) also. The correlation coefficients of all the fields were significant at = 0.05 since the p-values (Sig.) were less than 0.05, indicating that the fields were valid to measure what was set to meet the study's major goal.

3.8.5. Reliability Analysis

The stability of the questionnaire means making sure that the answer will be approximately the same if it is repeated to the same people at another time, and the researcher performed the stability test by applying Cronbach's alpha coefficient for each field of the questionnaire.

Cronbach's Alpha was 0.951 for the entire questionnaire, and varied from 0.750 to 0.945 for each section, which indicated excellent reliability of the entire questionnaire as shown in the table below:

Table 3.3: Cronbach's Alpha Value

Section	No. of items	Cronbach's Alpha coefficient
Implementing DMAIC methodology	36	0.945
Implementing TOC	15	0.75

Integrating DMAIC with TOC	6	0.887
Total	57	0.951

3.8.6. Frequency Distribution and Percentage of the Demographic Profile:

Table 3.4: Frequency distribution and percentage of the demographic profile

independent variables	**variable levels**	**Frequency**	**Percent**
Gender	male	75	68.2
	female	35	31.8
	total	**110**	100
Age	Less than 30 years	20	18.2
	30- less than 40 years	34	30.9
	40- less than 50 years	33	30.0
	50 or more	23	20.9
	Total	**110**	100.0
Education	diploma	18	16.4
	Bachelor	76	69.1
	master	15	13.6
	else	1	.9
	Total	**110**	100.0
job title	Quality Supervisor	23	20.9
	Quality Manager	21	19.1
	production manager	23	20.9
	factory manager	22	20.0
	general manager	21	19.1
years of experience	**Total**	**110**	100.0
	Less than 5 years	19	17.3
	5- Less than 10 years	36	32.7

	10- Less than 15 years	31	28.2
	more than 15 years	24	21.8
	Total	**110**	**100.0**
presence of a quality certificate	ISO	24	21.8
	PSI	6	5.5
	Both	12	10.9
	None	68	61.8
	Total	**110**	**100.0**

The demographic profile of the responders is presented in Table 3.4, which consists of six variables, whereas 31.8 % of the respondents were female as the researcher noticed that the jobs related to quality are mostly females, while the jobs related to processing and manufacturing are mostly males or 68.2%. The researcher can also observe from the above table that most of the participants were between 30 and less than 40 years old. On the other hand, Bachelor degree holders were 69.1 % of the whole participants, this may be due to the Ministry of Health licensing requirements, which requires the specialization of people in terms of their studies and the scientific certificate they hold in the departments in which they work, whether quality or manufacturing. The researcher noticed an equal percentage of the participants in filling out the questionnaire in terms of the job title since the researcher visited all the targeted factories to fill out the questionnaires, and also noticed the presence of a separate employee for each department of quality, manufacturing and testing laboratories in addition to the general manager, and this is also due to the requirements of the Ministry of Health licensing program as it requires the presence

of a separate employee for each department. Around sixty one percent of the factories were not having any quality certificate, the increase in the number of factories that do not have quality certificates is due to the high costs of annual and semi-annual audit rounds, which increases the burden on factories in avoiding high costs, which in turn is reflected in the prices of products and their competitiveness, but companies that work to export their products abroad need an ISO certificate, and in some cases, it is required to have a Palestinian quality certificate. Therefore, we see that only 10.9% of the companies participating in filling out the questionnaire possess both certificates together.

Chapter Four: Data Analysis, Interpretation and Discussion

This chapter of the study contains an analysis of the data collected by the researcher during the study and a discussion of the results of the research after the analysis that was carried out using the SPSS program.

4.1. Analyzing of Research Hypothesis:

The researcher used the Pearson Correlation test to study the relationship between the study variables. In the context of a linear relationship between two continuous variables, the term correlation is represented as Pearson product-moment correlation. In its broadest sense, correlation is a measure of a relationship between variables. A change in the magnitude of one variable is connected with a change in the magnitude of another variable in either the same (positive correlation) or opposite (negative correlation) direction in correlated data (Schober, Boer & Schwarte, 2018)

4.1.1. The Research Hypotheses

H1: "There is a significant relationship between the integration of the DMAIC methodology and TOC on quality improvement with alpha= 0.05."

Table 4.1: The correlation coefficient for thesis variables.

	Implementing DMAIC methodology	**Implementing TOC**
Pearson Correlation	0.559**	

	Sig.	0.000	
TOC	N	110	
Integrating DMAIC & TOC	Pearson Correlation	0.792**	0.485**
	Sig.	0.000	0.000
	N	100	110

According to the **Correlations Test**, shown in the above Table (*4.1*), the researcher found that the sig. value is less than 0.05, and there is a significant relationship at the level $\alpha \leq 0.05$ between TOC and DMAIC Methodology" therefore the hypothesis is accepted.

From the correlation test, the researcher noticed that there is a strong positive relationship between the application of the DMAIC methodology and TOC in the factories targeted in this study. This results came in consistent with the study that integrated DMAIC approach with TOC in LSS toward quality improvement in healthcare (Ahmad,2019)

H.2: "Integrating of DMAIC methodology and the TOC has a positive effect on the quality improvement of the cosmetics factories"

A positive effect could be measured after the application of the integration between DMAIC methodology and TOC, because the proof of this hypothesis needs to make changes and an actual application of the integration in a case study of the targeted companies and collecting data before and after improvement to make the comparison, These improvement projects need financing, while after

communicating with many cosmetics companies they all indicated that the current conditions of cosmetic manufacturing companies in Palestine are not able to finance the cost of the improvement project to prove the positive impact of integration on the quality of performance.

4.2. Analysis of Responses to Answer the Study Questions:

- **Q1**: What is the impact of integrating the DMAIC methodology and TOC in the cosmetics industry?

The researcher studied the literature and previous studies that were conducted on the cosmetics sector and the sectors close to the cosmetics sector, such as food manufacturing and the pharmaceutical industry, to conclude the impact of integrating the DMAIC methodology with TOC on it.

It was revealed that differentiating the aims of combination and rejection between the two techniques leads to a better understanding of the critical standards. In general, it was discovered that there are more focuses that overlap between the two techniques and that it is sensible to explore constructing an integrated continuous improvement measure that improves company competitiveness. The researcher also concluded that the integration between the DMAIC methodology and the theory of constraints (TOC) can be considered a powerful development tool because the integration of the two methodologies leads to constantly defining the strengths of the processes and keeping them strong and effective, and on the other hand discovering the weaknesses of the processes and also working continuously to

improve them to increase efficiency and proper use of resources, This is consistent with previous studies included by the researcher in chapter 2 of this thesis.

The researcher, also, designed some questions in the questionnaire to find out the extent to which the target factories agree on the variables of the DMAIC methodology separately and TOC and the integration between them.

4.2.1 Implementing DMAIC Methodology:

4.2.1.1 Define Phase:

Table 4.2: Descriptive statistics of the define phase

No.	Statement	Mean	STD	Variation	Degree of agreement
1	The problem faced by the organization is precisely defined	4.21	0.65	0.15	V.B.D
2	Available improvement opportunities are identified	4.01	0.69	0.17	B.D
3	Possibilities that may lead to product improvement are identified	3.92	0.71	0.18	B.D
4	Scope of work is defined for product improvement projects	4.26	0.64	0.15	V.B.D
5	Work is prioritized to improve products	4.29	0.65	.015	V.B.D
6	Vulnerabilities are identified for operations	3.79	0.82	0.21	B.D
7	the strengths of the operations are identified	3.05	0.96	.31	M.D
	Mean average	**3.93**	**0.73**	**0.16**	**B.D**

The results of the analysis are provided in Table 4.2. These statements were presented to the opinions of the respondents accordingly; it could be noted that the overall mean of the agreement about the defined phase was (M=3.93, S. D.=0.73), this means that the companies targeted in this study agree to a big extent on the application of the variables of the define stage. The researcher also noted that statement number five got the highest agreement degree in this phase besides

statement number four, which indicates that the companies are prioritizing the work and also defining the work scope for improvement projects. On the other hand, the statement that states (the strengths of the operations are identified) obtained a low value of mean reached (3.05), may indicate that the companies participating in the study do not significantly identify the strengths of their operations.

4.2.1.2 Measure Phase:

Table 4.3: Descriptive statistics of the measure phase.

No.	Statement	Mean	STD	Variation	Degree
1	Process performance measurement tools are identified	3.63	0.83	0.22	B.D
2	Usually measuring instruments are suitable for the purpose they are measuring	3.98	0.63	0.15	B.D
3	The performance level of the operations in the organization is determined	4.12	0.78	0.18	B.D
4	Objectives are set in harmony with the mission of the organization.	4.43	0.59	0.13	V.B.D
5	The goals set are measurable	4.08	0.57	.014	B.D
6	Objectives that are set related to the process to be improved	4.42	0.59	0.13	V.B.D
	Mean average	**4.10**	**0.66**	**0.13**	B.D

When analyzing the variables of the measurement stage, the researcher concluded that the targeted participants are setting the objectives for the improvement process in a way that is consistent with the goals of their companies, in the same context, the researcher believes that the participants agree to a very large extent on sentence number five, which means that they largely set goals directly related to the processes they want to improve, also, to a large extent, they agree that they are selecting appropriate measurement tools for the operations they measure. This indicates that the participants from the companies targeted to be studied know the need to use

appropriate measurement tools for each stage and each process, and the need for the improvement objectives set to be measurable and compatible with the objectives of the company.

4.2.1.3 Analyze Phase:

Table 4.4: Descriptive statistics of the analyze phase.

No.	Statement	Mean	STD	Variation	Degree
1	Possible reasons for the deviation are analyzed	3.84	0.79	0.21	B.D
2	The main reasons for the deviation are analyzed	4.06	0.72	0.17	B.D
3	Negative deviation is analyzed according to the objectives set	3.55	0.72	0.20	B.D
4	Positive deviation is analyzed according to the stated goals	2.95	0.81	0.27	M.D
5	The company is conducting an investigation of the causes of deviation	3.55	0.83	0.23	B.D
6	The company analyzes deviations statistically	1.94	0.99	0.51	W.D
7	The main reasons are proven by the data	3.15	0.82	0.26	M.D
	Mean average	**3.29**	**0.81**	**0.26**	M.D

From the data in the table above (*4.4*), the researcher deduced some points regarding the analysis phase, first of all, the researcher was able to notice through the interviewing the participants that there is a variation in the participants' answers to sentence number six and that the participants agreed to it to a weak degree, the existence of the variation can be explained by the fact that some companies actually study the deviations that occur statistically, while the largest number of companies do not collect sufficient data to analyze the deviations statistically, Secondly, it was observed that the participants agree with a moderate degree on sentence number four and sentence number seven, which indicates that part of companies usually

does not analyze positive deviations to find out their causes and also not to prove the main causes of deviations by the data. Companies are satisfied with knowing the main reason that led to the deviation.

4.2.1.4 Improve Phase:

Table 4.5: Descriptive statistics of the improve phase.

No.	Statement	Mean	STD	Variation	Degree
1	The institution determines the causes of deviations	4.06	0.62	0.15	B.D
2	An optimal solution is found for the identified deviations	4.02	0.63	0.16	B.D
3	The suitability of the solution is tested before it is applied	3.54	1.02	0.28	B.D
4	The solution is selected according to the expected process performance	3.86	0.87	0.22	B.D
5	The solution is chosen according to the cost principle	3.95	0.86	0.23	B.D
6	The solution is chosen according to the demands of the operations	4.15	0.71	0.21	B.D
7	The solution is chosen according to the expected risks	4.31	0.61	0.14	V.B.D
8	Operations are improved by studying the operational risks faced by the organization	4.26	0.60	0.14	V.B.D
	Mean average	**4.02**	**0.74**	**0.19**	B.D

The most important phase is the improvement phase and in this stage, the researcher conclude that the companies are continuously improving the quality since the overall mean for the improvement phase is 4.02. This means that the targeted companies largely agree with the sentences mentioned at this stage, and therefore companies usually identify the causes of deviations and work to find an appropriate solution for the reasons that led to the occurrence of deviations and also study to a large extent these solutions before applying them and usually choose these solutions

according to the principle of cost It also takes into account operational needs and operational risks.

4.2.1.5 Control Phase:

Table 4.6: Descriptive statistics of the control phase.

No.	Statement	Mean	STD	Variation	Degree
1	The optimal solution for deviations is applied according to the plan	4.01	0.64	0.16	B.D
2	The solution is being followed up	3.96	0.71	0.18	B.D
3	Improvements are proven	3.61	0.74	0.20	B.D
4	Measurement systems efficiency is analyzed	3.25	0.85	0.26	M.D
5	Processes are documented according to the expected outputs	3.79	0.86	0.22	B.D
6	Work mechanisms are defined to control new ways of working after improvement	4.27	0.66	0.15	V.B.D
7	The responsible person is determined to follow up on quality deviations	4.28	0.74	0.17	V.B.D
8	It is ensured that the adjustments made are documented	3.97	0.80	0.20	B.D
	Mean average	**3.89**	**0.75**	**0.19**	B.D

It is important to ensure that the outputs of the improvement process are sustainable, and when analyzing the participant responses for the control phase. The researcher observed that the answers of the participants from the targeted companies ranged from approved, approved to a large degree, and approved to a very large degree, but some companies do not analyze the efficiency of measurement systems, as the average response rate for the sentence states “Measurement systems efficiency is analyzed” was to a moderate degree (3.25).

Table 4.7: Descriptive statistics of DMAIC five phases.

No.	phase	Mean	STD	Variation	Degree
1	Define	3.93	0.73	0.16	B.D
2	Measure	4.10	0.66	0.13	B.D
3	Analyze	3.29	0.81	0.26	M.D
4	Improve	4.02	0.74	0.19	B.D
5	Control	3.89	0.75	0.19	B.D
	Mean average	**3.84**	**0.74**	**0.18**	B.D

The overall mean of virtually implementing DMAIC methodology in the targeted companies was (*M= 3.84*) for the five phases with a standard deviation *(0.74),* This may indicate that the companies participating in the study agree to a large extent with the sentences mentioned in the stages of application of the DMAIC methodology, which leads the researcher to conclude that the companies that implement the requirements of the Ministry of Health for licensing are already on the way to implement the terms and stages of the DMAIC methodology

4.2.2 Implementing of TOC:

Table 4.8: Descriptive statistics of the TOC implementation variables.

No	statement	Mean	Std. Deviation	Variation	Degree
1	The objectives of the process under study are defined	4.29	0.59	0.14	V.B.D
2	The objectives of the operation under study are constantly updated	3.23	0.88	0.27	M.D
3	The constraint/ constraints that prevent the achievement of objectives are identified	3.70	0.64	0.17	B.D
4	It is ensured that the limitation / restrictions are avoided	3.59	0.70	0.19	B.D
5	It is ensured that the process is working properly	4.06	0.57	0.14	B.D

6	It is ensured that the process is being exploited in the correct way	3.98	0.69	0.17	B.D
7	processes that are related to the Constraint/Constraints are improved	3.69	0.67	0.18	B.D
8	The company is improving the efficiency of the process	3.83	0.71	0.18	B.D
9	The most appropriate solution to get rid of the restriction/restrictions is agreed upon	4.23	0.63	0.15	V.B.D
10	The above process is repeated as often as necessary	3.95	0.68	0.17	B.D
	Mean average	**3.85**	**0.67**	**0.17**	**B.D**

According to the table above *(4.8)* ,sentence number one which states "The objectives of the process under study are defined" gained the highest mean (4.29), followed by "The most appropriate solution to get rid of the restriction/restrictions is agreed upon" (M= 4.23) after that the statement " It is ensured that the process is working properly" (M=4.06), the researcher believes that the targeted companies, with a very big degree, are applying the sentences mentioned in the paragraph about the theory of constraints in their companies, regardless of their previous knowledge of it or not, other targeted companies are applying the sentences to a lesser degree. And this approves that the companies are using TOC in improving the company's quality.

4.2.3 Integrating of DMAIC Methodology and TOC:

Table4.9: Descriptive statistics of the integrating DMAIC with TOC.

No.	Statement	Mean	STD	Variation	Degree
1	The problem and expected constraints are identified	4.13	0.62	0.15	B.D

2	Opportunities for improvement are identified according to expected constraints	3.77	0.77	0.20	B.D
3	Measuring tools are chosen so that they are suitable for measuring the output according to the expected constraints	3.30	0.69	0.20	M.D
4	An investigation is being conducted to find out the reasons for the detected constraints	3.66	0.74	0.20	B.D
5	T0he optimal solution to the deviations is found according to the constraints that have been identified	3.74	0.67	0.18	B.D
6	The solution for deviations and limitations discovered is documented	3.52	0.92	0.26	B.D
	Mean average	**3.68**	**0.73**	**0.16**	B.D

It can be concluded that the targeted factories' participants agreed to a big degree in integrating DMAIC methodology and TOC in their companies. The results also show that the highest variables ranked in descending order according to their relative weight are as follows:

- The problem and expected constraints are identified with a mean of 4.13 and a St. deviation of 0.62.
- Opportunities for improvement are identified according to expected constraints with a mean of 3.77 and a St. Deviation of 0.77.
- The optimal solution to the deviations is found according to the constraints that have been identified with a mean of 3.74 and a St. Deviation of 0.67.
- An investigation is being conducted to find out the reasons for the detected constraints with a mean of 3.66 and a St. Deviation of 0.74.
- The solution for deviations and limitations discovered is documented with a mean of 3.52 and a St. Deviation of 0.92.

In this paragraph also, the researcher concludes that there is a weakness in choosing the appropriate measuring tools for measuring operations and their constraints. These results are in total agreement with The studies of Bauer et al., (2016) and Gupta et al., (2019), which stated that these two methodologies would help the medical care association to break down medical care execution, for example, understanding safety of the patient, monetary results, which are problems that need to be addressed.

- **Q.2**: What are the main constraints that limit the quality improvement in the cosmetics factories concerning the DMAIC methodology and TOC?

- **Q.3**: What are the effects of integrating DMAIC methodology and TOC in reducing these constraints?

Table4.10: Descriptive statistics of the constraints faced by the companies.

No.	Statement	Mean	STD	Variation	Degree
1	The company faces constraints in the process of supplying raw materials	3.15	0.95	0.30	M.D
2	The company faces constraints in providing manpower	4.05	0.91	0.22	B.D
3	The company faces restrictions in the process of storing finished goods	3.00	0.94	0.31	M.D
4	The company faces constraints in the process of storing raw materials	2.91	1.01	0.34	M.D
5	The company faces restrictions in marketing its products	4.13	1.11	0.18	B.D
	Mean average	**3.44**	**0.98**	**0.28**	**B.D**

When the researcher studied the constraints faced by the targeted factories, and also after conducting interviews with quality managers and general managers in the factories that were visited, the researcher concluded that the biggest constraint for cosmetic manufacturing companies in Palestine is the inability to market the products effectively, followed by the constraints of providing expert manpower in the field, then the constraint to providing the raw materials needed for the manufacturing process, then the companies facing constraints in storing finished goods, and it seems that they face simple constraints in storing raw materials, this can be explained by the need for companies to commit to using raw materials as soon as they reach the companies' stores, and this was a condition of the Palestinian Ministry of Health to ensure high quality of cosmetics

It can be said that many restrictions exist in the cosmetics industry in Palestine, including the lack of expert manpower, as well as the difficulty of marketing local products. After analyzing the results of this study, as well as other previous studies (Bom et al., 2019; Mabin et al., 2018; Boleneni, 2016) that integrated the DMAIC methodology and TOC, the application of this integration leads significantly to reducing these constraints to improve the quality of the operations outputs. These results are in agreement of studies carried out by Pesic et al (2013, Tabish et al (2015), Al Amin et al (2017). These studies were about, TOC helps in decreasing cost and gives higher profits, TOC is fundamental in association productivity and fruitful activities, throughput expansion, increase in outcomes and profits, respectively.

Out of the interviews conducted by the researcher with the targeted companies and comparing the data collected, the researcher can conclude that the companies whose degree of agreement to the application of the integration between DMAIC methodology and TOC was between a medium to a big degree are indeed companies that work to improve the quality of performance, and when linking this finding with previous studies, the researcher concluded that the integration between DMAIC methodology and TOC is an effective tool that can be adopted in solving bottlenecks radically, in a role that will lead to the efficient exploitation of available resources This is in a total agreement with Al Amin et al (2017).

As the use of the theory of constraints to understand the process or operation or system and identify the weak activity in it, then take advantage of the DMAIC methodology in terms of its five phases (definition the constraint, use of appropriate measurement tools, analyze the deviations, improve the activity and every related activity, and control the new improved process) and identification and the use of appropriate measurement tools) will lead to improving the performance of that activity that constitutes a constraint and moving to another constraint to avoid and repeat the process constantly. This is in agreement with the results of Tabish et al (2015).

When studying the relationship between the company's possession of a quality certificate, it was found that there is a small difference in the answers of companies that possess at least one quality certificate and companies that do not have quality certificates, the researcher concludes that there is a strong positive relationship

between the company's possession of a quality certificate and the company's application of the integration between the DMAIC methodology and TOC, as well as the existence of a strong relationship between the company's possession of the quality certificate and its application to each of the items of the analysis and control stages, according to the ANOVA test tables (D.5 & D.6) shown in Appendices. These results are compared to results by Bernardi et al (2008), Kendall (2005), Schragenheim (2002), and Singh and Misra, (2018).

4.3. The Research Results

The purpose of this study was to find out the effect of the integration between the DMAIC methodology in Six Sigma and TOC, and accordingly, after conducting the study on the targeted cosmetics factories in Palestine and based on the statistical analysis, testing its hypotheses, and the interviews the study reached the following results:

1. Companies have no prior knowledge of TOC and some had a simple conception of DMAIC methodology and Six Sigma.
2. Companies prioritize work on improvement projects.
3. Scope of work is defined for product improvement projects.
4. Objectives are set in harmony with the mission of the organization.
5. Objectives are set related to the process to be improved.
6. Companies analyze the reasons for the deviations that occur.

7. Operations are improved by studying the operational risks faced by the organization.

8. Companies set goals and objectives for the improvement process.

9. When companies encounter certain constraints, they make sure that the activity or process works in the best way before looking for the most proper solutions to the obstacle.

10. Some cosmetics manufacturing companies in Palestine in a simple way apply the integration between the DMAIC methodology and TOC, as they identify the problems they face and the constraints on them; it also identifies opportunities for improvement and expected constraints during implementation following DMAIC methodology steps and some of TOC steps.

Chapter Five: Conclusion, Recommendations and Limitations

This part of the study presents the conclusions that the research has concluded. It also presents recommendations and addresses for future studies that the researcher believes are important to implement in order to reach a deeper and clearer understanding of the integration between the DMAIC methodology and the theory of constraints.

5.1 Conclusion

From all of the above mentioned results, it can be concluded:

- The biggest constraints facing the cosmetics industry in Palestine is the problem of marketing the products and also the constraint of providing expert manpower in this field, as well as impeding the storage of the finished products, and accordingly the researcher concluded when linking the results with previous studies, the integration

between the DMAIC methodology and TOC have significant impact on reducing the constraints faced by factories working in cosmetics.

- When applying the integration of the DMAIC methodology and TOC, the constraints faced by factories are minimized.
- The application of the integration between the DMAIC methodology and TOC leads to the improvement of the quality of outputs in cosmetic factories.
- The companies' commitment to the licensing terms led to the existence of an integrated quality system, which had a positive impact on the quality of both the output and the system.
- The existing organizations in Palestine are conscious of the importance of quality and the importance of having a quality system in factories working specifically in the field of medicines and cosmetics.

5.2 Recommendations:

In light of the study's findings, a set of recommendations can be presented. We hope that it will be useful to those who are specialists in the field.

- As the factories in Palestine are interested in the field of quality and at the same time do not have sufficient knowledge in the theory of constraints, which helps the factories in discovering and reducing the constraints in their operations, awareness-raising workshops should be held about quality in general, the theory of constraints, and the DMAIC methodology in particular.

- There are a few opportunities for fostering this line of exploration further, for example, a) a correlation between small industrial companies, to produce further experimental components for contrasting between associations; b) a study including firms from various industrial areas; c) contrasting studies pointed toward recognizing differences in production techniques because of various spaces of activity.
- To accomplish the objectives of an organization, directors of organizations should deal with day-to-day activities and analyze on a regular basis what is going on within their organization. Therefore, Goldratt and Cox (1992) recommended 3 essential models, throughput, stock, and operational expenses. These measures are utilized for continually looking for another bottleneck and unused limit, to guarantee harmonization of the work course through the whole organization.
- The expansion of TOC makes a powerful mix for rapidly discovering root causes and delivering arrangements with an immediate primary concern sway. No matter what the industry is, TOC can save time, exertion, and cash when managing with measure imperatives and efficiency improvement objectives, and empower associations to more readily serve all partners, counting clients, providers, colleagues, and managers.
- Generally, EU organizations have had little accomplishment in infiltrating the market in Japan and China. Regulatory hindrances may have been an issue for EU firms previously, nonetheless, but it was tracked down that the availability of the Japanese cosmetics market has extraordinarily improved since it was deregulated. Deregulation incorporated the cancelation of pre-market endorsement, the

foundation of a disallowed ingredients list like the EU, and the annulment of the assigned ingredients list. This could be the case in our Palestinian market, since the Ministry of Health, Ministry of Economics, and Palestinian Standard Institute are setting the rules for the cosmetics business which are very firm and hard to absorb and abide by.

- Operating companies and partner institutions should provide specialized professional training to increase the efficiency and expertise of the workforce in the field of cosmetic manufacturing, as well as provide training in the field of quality application and total quality management.

- In order to continue to expend effort in the future of TOC with SS and other CI methods, the researcher propose the joining of a TOC system and thinking process (TP). TP is a strategy created dependent on circumstances and logical results determined to get its connection between different pieces of the whole framework (McMullen, 1998; Scheinkopf, 1999). It helps recognize center issues, contrive goals, and bit by bit execution plan, settling likely contentions of protection from changes, and requesting support from top management and staff. While TP was initially created to oversee non-physical imperatives (for example approaches and measurements frameworks), it could likewise be applied to oversee physical imperatives (for example production bottleneck). TP method has been used successfully by a number of businesses to make important policy changes as well as to gain employee purchase in to help improve projects (Noreen et al., 1995;

Schragenheim, 1998). Future incorporation of TP with other CI strategies ought to give incredible potential to making fruitful CI.

5.3 Study Limitation:

There are many obstacles faced by the researcher. The main problem is the Covid-19 closures and its related issues that the whole world has been suffering from, especially the manufacturing sector due to the lack of available raw materials. The lack of research related to TOC adoption in Palestine is considered the most important constraint of this study, and also the lack of studies that integrating DMAIC methodology and TOC for cosmetics factories, which has hampered the findings of this study.

The time was so limited that the researcher could not gather and study the data easily. And also most of the factories were adopting a 70% shift system. This was a challenge for the researcher to collect the necessary and sufficient data.

Another obstacle that the researcher faced while collecting data is the frequent closures of city entrances due to the confrontations that were taking place at the entrances to the cities of the West Bank in protesting against the Israeli aggression on Gaza and Al-Aqsa Mosque, which posed another challenge to collecting data on time.

5.4 Further Research:

1. The researcher recommends the implementation of other future studies in this field, where it is useful to conduct a study on a specific cosmetic company to

accurately find the effects of applying the integration between DMAIC methodology and TOC.

2. It is possible to study specific variables and apply integration and study the same variables after improvement on processes and activities using the integration between the DMAIC methodology and TOC

3. This will lead us to know the exact constraints that face cosmetic manufacturing companies in Palestine, and also will lead us to know the impact of integration on these constraints and the company as a whole.

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Appendices

Appendix (A): Questionnaire, Arabic version

الجامعة العربية الأمريكية
ARAB AMERICAN UNIVERSITY
FACULTY OF GRADUATE STUDIES

الجامعة العربية الأمريكية
كلية الدراسات العليا / برنامج إدارة الجودة الشاملة

أخي الفاضل / أختي الفاضلة

تحية طيبة وبعد،

تأتي هذه الاستبانة استكمالا لرسالة الماجستير بعنوان "دمج منهجية DMAIC في ستة سيجما ونظرية القيود نحو تحسين الجودة في صناعة مستحضرات التجميل في فلسطين". وذلك في إطار الحصول على درجة الماجستير في إدارة الجودة الشاملة ومن أجل تحقيق هذه الغاية الرجاء تعبئة الاستبانة بالإجابة عن الأسئلة بجودة وصدق، قد يستغرق وقت الإجابة عن الاستبانة 15 دقيقة تقريبًا. إن البيانات التي تجمع من خلال هذه الاستبانة سيتم استخدامها لأغراض البحث العلمي فقط مع الحفاظ على السرية التامة لهذه البيانات.

مع الشكر والتقدير،،،

الباحثة
إسراء دسوقي

للتواصل مع الباحثة لأي استفسار عبر البريد الإلكتروني isradasoqe.qaisi@gmail.com

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القسم الأول: البيانات الديموغرافية

1.1 يرجى تحديد الجنس

❑ ذكر ❑ أنثى

1.2 الفئة العمرية

❑ أقل من 30 سنة ❑ 30- اقل من40 سنة

❑ 40- أقل من 50 سنة ❑ 50- فأكثر

1.3 المؤهل العلمي

❑ دبلوم ❑ بكالوريوس

❑ ماجستير ❑ غير ذلك، حدد .....

1.4 يرجى تحديد المسمى الوظيفي

❑ مشرف جودة ❑ مدير جودة

❑ مدير إنتاج ❑ مدير مصنع

❑ مدير عام ❑ غير ذلك، حدد.....

1.5 سنوات الخبرة

❑ أقل من 5 سنوات ❑ 5- أقل من 10 سنوات

❑ 10- أقل من 15 سنة ❑ أكثر من 15 سنة

1.6 تمتلك الشركة شهادة جودة:

❑ أيزو ❑ الجودة الفلسطينية

❑ الاثنان معاً ❑ لا تمتلك شهادة جودة

القسم الثاني :تطبيق منهجية DMAIC في المؤسسة:

DMAIC Methodology

منهجية DMAIC هي أداة في لين سته سيجما للتحسين المستمر للعمليات وترتكز على خمسة مفاهيم أساسية (define, measure, analyze, improve , and control) بناء عليه أرجو الإجابة

بمدى تطبيق الجمل الآتية في مؤسستك: وفق تدرج ليكرت الخماسي، "حيث 5 تمثل "درجة كبيرة جدا، 4 تمثل درجة كبيرة، 3 تمثل درجة متوسطة، 2 تمثل درجة ضعيفة، 1 تمثل درجة ضعيفة جدا".

1.1 مرحلة التحديد (Define phase) يمكن وصف الغرض من مرحلة التحديد على النحو الآتي: وصف المشاكل التي تحتاج إلى حل ووزن المشكلة بالنسبة للمؤسسة و تنظيم فريق التحسين.

		د.ك.ج	د.ك	د.م	د.ض	د.ض.ج
1	يتم تحديد المشكلة التي تواجهها المؤسسة بشكل دقيق	5	4	3	2	1
2	يتم تحديد فرص التحسين المتاحة	5	4	3	2	1
3	يتم تحديد الاحتمالات التي قد تؤدي إلى تحسين المنتجات	5	4	3	2	1
4	يتم تحديد نطاق العمل لمشاريع تحسين المنتجات	5	4	3	2	1
5	يتم تحديد أولويات العمل لتحسين المنتجات	5	4	3	2	1
6	يتم تحديد نقاط الضعف للعمليات	5	4	3	2	1
7	يتم تحديد نقاط القوة للعمليات	5	4	3	2	1

1.2 مرحلة القياس (Measure phase) أهداف مرحلة القياس هي: تحديد العيب وجمع المعلومات الأساسية المتعلقة بأداء العملية، تحديد أهدافًا للتحسين والتأكد من وجود نظام مناسب للقياسات في المؤسسة.

		د.ك.ج	د.ك	د.م	د.ض	د.ض.ج
1	يتم تحديد أدوات لقياس أداء العمليات	5	4	3	2	1
2	عادة ما تكون أدوات القياس ملائمة للغرض الذي تقيسه	5	4	3	2	1
3	يتم تحديد مستوى أداء للعميات في المؤسسة	5	4	3	2	1
4	توضع الأهداف بشكل منسجم مع رسالة المؤسسة.	5	4	3	2	1
5	تكون الأهداف الموضوعة قابلة للقياس	5	4	3	2	1
6	الأهداف التي يتم وضعها مرتبطة بالعملية المستهدف تحسينها	5	4	3	2	1

1.3مرحلة التحليل (Analyze phase) الهدف من مرحلة التحليل هو: تحدد المعطيات للعملية، أو

المدخلات، التي لها أكبر تأثير على نتائج العملية (المخرجات).

		د.ك.ج	د.ك	د.م	د.ض	د.ض.ج
1	يتم تحليل الأسباب المحتملة التي أدت لحدوث الاختلاف	5	4	3	2	1
2	يتم تحليل الأسباب الرئيسة التي أدت لحدوث الاختلاف	5	4	3	2	1
3	يتم تحليل الانحراف السلبي وفقا للأهداف الموضوعة	5	4	3	2	1
4	يتم تحليل الانحراف الإيجابي وفقا للأهداف المعلن عنها	5	4	3	2	1
5	تقوم المؤسسة بعمل تحقيق لأسباب الاختلاف	5	4	3	2	1
6	تلجأ المؤسسة لتحليل الانحرافات إحصائيا	5	4	3	2	1
7	يتم إثبات الأسباب الرئيسة بالبيانات	5	4	3	2	1

1.4 مرحلة التحسين (Improve phase) الهدف الرئيس في هذه المرحلة هو: تحديد فرص التحسين، مدعومة بمعلومات عن الطريقة التي تساعد بها هذه التحسينات في تحقيق أهداف مشروع التحسين.

		د.ك.ج	د.ك	د.م	د.ض	د.ض.ج
1	تقوم المؤسسة بتحديد أسباب الانحرافات	5	4	3	2	1
2	يتم إيجاد الحل الأمثل للانحرافات التي تم تحديدها	5	4	3	2	1
3	يتم اختبار مناسبة الحل قبل تطبيقه	5	4	3	2	1
4	يتم اختيار الحل وفق أداء العملية المتوقع	5	4	3	2	1
5	يتم اختيار الحل وفق مبدأ التكلفة	5	4	3	2	1
6	يتم اختيار الحل وفق مطالب تنفيذ العمليات	5	4	3	2	1
7	يتم اختيار الحل وفق المخاطر المتوقعة	5	4	3	2	1
8	يتم تحسين العمليات من خلال دراسة المخاطر التشغيلية التي تواجهها المؤسسة	5	4	3	2	1

1.5 مرحلة التحكم (Control phase) لتنفيذ الحلول المختارة والتأكد من أنها مترسخة في العملية التحسينية.

		د.ك.ج	د.ك	د.م	د.ض	د.ض.ج
1	يتم تطبيق الحل الأمثل للانحرافات حسب الخطة	5	4	3	2	1

2	يتم متابعة تطبيق الحل	5	4	3	2	1
3	يتم إثبات عمليات التحسين	5	4	3	2	1
4	يتم تحليل كفاءة أنظمة القياس	5	4	3	2	1
5	يتم توثيق العمليات وفق المخرجات المتوقعة	5	4	3	2	1
6	يتم تحديد آليات العمل للتحكم بطرق العمل الجديدة بعد التحسين	5	4	3	2	1
7	يتم تحديد الشخص المسؤول لمتابعة انحرافات الجودة	5	4	3	2	1
8	يتم التأكد أن التعديلات التي تم إجراؤها تم توثيقها	5	4	3	2	1

القسم الثالث: تطبيق نظرية القيود

نظرية القيود هي نهج علمي للتحسين. يفترض أن أي نظام معقد، بما في ذلك العمليات التجارية، يتكون من عدة أنشطة مرتبطة مع بعضها البعض. يعمل أحد هذه العناصر قيدا للنظام بأكمله (أي نشاط القيد هو "الحلقة الأضعف في السلسلة"). يوفر TOC منهجية شديدة التركيز لتحقيق تحسينات سريعة وتحديد أهداف المنظمة، والعوامل التي تعيق تحقيق هذه الأهداف، وبذلك تتحسن من خلال محاولة التخفيف أو الحد من العوامل المحددة. وتيم تنفيذها على ست مراحل على النحو الآتي: تحديد هدف قابل للقياس، تحديد القيد، الاستفادة من القيد، تحسين القيد والعمليات المرتبطة به، زيادة كفاءة القيد وقدرته، وأخيرا البحث عن قيد آخر وإعادة العملية ككل.

بناء على ما سبق أرجو تحديد درجة موافقتك على كل عبارة من العبارات الآتية:

		د.ك.ج	د.ك	د.م	د.ض	د.ض.ج
1	يتم تحديد أهداف العملية قيد الدراسة	5	4	3	2	1
2	يتم تحديث أهداف العملية قيد الدراسة باستمرار	5	4	3	2	1
3	يتم تحديد القيد / القيود التي تمنع تحقيق الأهداف	5	4	3	2	1
4	يتم التأكد أن القيد / القيود قد تم تلافيه	5	4	3	2	1
5	يتم التأكد أن العملية تعمل على أكمل وجه	5	4	3	2	1
6	يتم التأكد من أن العملية يتم استغلالها بالطرق الصحيحة	5	4	3	2	1

7	يتم تحسين العمليات المرتبطة بالقيد / القيود	5	4	3	2	1
8	تقوم المؤسسة بتحسين كفاءة العملية	5	4	3	2	1
9	يتم الاتفاق على الحل الأنسب للتخلص من القيد / القيود	5	4	3	2	1
10	يتم تكرار العملية السابقة كلما لزم الأمر	5	4	3	2	1
11	تواجه الشركة قيودا في عملية توريد المواد الخام	5	4	3	2	1
12	تواجه الشركة قيودا في توفير أيدٍ عاملة	5	4	3	2	1
13	تواجه الشركة قيودا في عملية تخزين البضاعة الجاهزة	5	4	3	2	1
14	تواجه الشركة قيودا في عملية تخزين المواد الخام	5	4	3	2	1
15	تواجه الشركة قيودا في تسويق منتجاتها	5	4	3	2	1

القسم الرابع: دمج منهجية DMAIC مع نظرية القيود

أرجو تحديد درجة موافقتك على كل عبارة من العبارات الآتية :

		د.ك.ج	د.ك	د.م	د.ض	د.ض.ج
1	يتم تحديد المشكلة والقيود المتوقعة	5	4	3	2	1
2	يتم تحديد فرص التحسين وفق القيود المتوقعة	5	4	3	2	1
3	يتم اختيار أدوات قياس بحيث تكون مناسبة لقياس المخرجات وفق القيود المتوقعة	5	4	3	2	1
4	يتم إجراء تحقيق لمعرفة أسباب القيود التي تم اكتشافها	5	4	3	2	1
5	يتم إيجاد الحل الأمثل للانحرافات وفق القيود التي تم تحديدها	5	4	3	2	1
6	يتم توثيق الحل للانحرافات والقيود التي تم اكتشافها	5	4	3	2	1

يرجى كتابة أية ملاحظات أو اقتراحات لديكم

انتهت الأسئلة مع خالص شكري وتقديري لكم،،،،

إسراء دسوقي

Appendix (B): Questionnaire, English version

الجامعة العربية الأمريكية
ARAB AMERICAN UNIVERSITY
FACULTY OF GRADUATE STUDIES

Arab American University
College of Graduate Studies / Total Quality Management Program

Dears,

This questionnaire comes as a continuation of the master's thesis entitled "Integrating DMAIC Methodology in Six Sigma and Theory of Constraints towards Quality Improvement in the Cosmetics Industry in Palestine". In the context of obtaining a master's degree in total quality management, and in order to achieve this goal, please fill out the questionnaire by answering the questions honestly. The time to answer the questionnaire may take approximately 15 minutes The data collected through this questionnaire will be used for scientific research purposes only, while maintaining the strictest confidentiality of this data.

With thanks and appreciation,

Researcher
Isra' Dasoqe

To contact the researcher for any inquiries, please email
isradasoqe.qaisi@gmail.com
Or on a phone number: 0569341345

Section One: Demographic Data

1.1 gender

❑ male ❑ female

1.2 age

❑ less than 30 years ❑ 30-less than 40 years

❑40 -less than 50 years ❑ more than 50 years

1.3 education

❑ Diploma ❑ Bachelor

❑master ❑ else, please specify……

1.4 Job title

❑ Quality Supervisor ❑ Quality Manage

❑ production manager ❑ factory manager

❑ general manager ❑ else, please specify.....

1.5 Years of Experience

❑ Less than 5 years ❑5 - Less than 10 years

❑10 - Less than 15 years ❑ more than 15 years

1.6The company has a quality certificate:

❑ ISO ❑ PSI

❑ Both ❑ None

Section Two: Application of the DMAIC Methodology in the Institution:

DMAIC Methodology

The DMAIC methodology is a tool in Lean Six Sigma for continuous improvement of operations and is based on five basic concepts (define, measure, analyze, improve, and control). big degree, 4 representing big degree, 3 representing medium degree, 2 representing weak degree, 1 representing very weak degree".

1.1 Define phase The purpose of the define phase can be described as follows:

Describe the problems that need to be solved, weigh the problem for the organization, and organize the improvement team.

		V.B.D	B.D	M.D	W.D	V.W.D
1	The problem faced by the organization is precisely defined	5	4	3	2	1
2	Available improvement opportunities are identified	5	4	3	2	1
3	Possibilities that may lead to product improvement are identified	5	4	3	2	1
4	Scope of work is defined for product improvement projects	5	4	3	2	1
5	Work is prioritized to improve products	5	4	3	2	1
6	Vulnerabilities are identified for operations	5	4	3	2	1
7	the strengths of the operations are identified	5	4	3	2	1

1.2 Measure phase, the objectives of the measurement phase are: identifying the defect and collecting basic information related to the performance of the process, setting goals for improvement and ensuring that there is an appropriate system for measurements in the organization.

		V.B.D	B.D	M.D	W.D	V.W.D
1	Process performance measurement tools are identified	5	4	3	2	1
2	Usually measuring instruments are suitable for the purpose they are measuring	5	4	3	2	1
3	The performance level of the operations in the organization is determined	5	4	3	2	1
4	Objectives are set in harmony with .the mission of the organization	5	4	3	2	1
5	The goals set are measurable	5	4	3	2	1
6	Objectives that are set related to the process to be improved	5	4	3	2	1

1.3 Analyze phase, the objective of the analysis phase is: Determine the data for the process, or the inputs, that have the greatest impact on the process results (outputs).

		V.B.D	B.D	M.D	W.D	V.W.D
1	Possible reasons for the deviation are analyzed	5	4	3	2	1
2	The main reasons for the deviation are analyzed	5	4	3	2	1
3	Negative deviation is analyzed according to the objectives set	5	4	3	2	1
4	Positive deviation is analyzed according to the stated goals	5	4	3	2	1
5	The institution is conducting an investigation of the causes of deviation	5	4	3	2	1
6	The institution analyzes deviations statistically	5	4	3	2	1
7	The main reasons are proven by the data	5	4	3	2	1

1.4 Improve phase, the main objective in this phase is to: Identify opportunities for improvement, supported by information on how these improvements help achieve the objectives of the improvement project.

		V.B.D	B.D	M.D	W.D	V.W.D
1	The institution determines the causes of deviations	5	4	3	2	1
2	An optimal solution is found for the identified deviations	5	4	3	2	1
3	The suitability of the solution is tested before it is applied	5	4	3	2	1
4	The solution is selected according to the expected process performance	5	4	3	2	1
5	The solution is chosen according to the cost principle	5	4	3	2	1
6	The solution is chosen according to the demands of the operations	5	4	3	2	1
7	The solution is chosen according to the expected risks	5	4	3	2	1

8	Operations are improved by studying the operational risks faced by the organization	5	4	3	2	1

1.5 Control phase to implement the selected solutions and ensure that they are rooted in the improvement process.

		V.B.D	B.D	M.D	W.D	V.W.D
1	The optimal solution for deviations is applied according to the plan	5	4	3	2	1
2	The solution is being followed up	5	4	3	2	1
3	Improvements are proven	5	4	3	2	1
4	Measurement systems efficiency is analyzed	5	4	3	2	1
5	Processes are documented according to the expected outputs	5	4	3	2	1
6	Work mechanisms are defined to control new ways of working after improvement	5	4	3	2	1
7	The responsible person is determined to follow up on quality deviations	5	4	3	2	1
8	It is ensured that the adjustments made are documented	5	4	3	2	1

Section Three: Applying the Theory of Constraints

The theory of constraints is a scientific approach to improvement. It assumes that any complex system, including business processes, consists of several activities that are linked together. One of these elements acts as a constraint for the entire system (i.e. the constraint activity is the "weakest link in the chain"). TOC provides a highly focused approach to achieving rapid improvements and identifying the goals of the organization, and the factors that hinder the achievement of those goals by trying to mitigate or reduce the identified factors. It was implemented in six stages as follows: setting a measurable goal, determining the constraint, taking advantage of the constraint, improving the constraint and its related processes, increasing the efficiency and capacity of the constraint, and finally searching for another constraint and repeating the process

as a whole.

Based on the foregoing, please specify the degree of your agreement with each of the following statements:

		V.B.D	B.D	M.D	W.D	V.W.D
1	The objectives of the process under study are defined	5	4	3	2	1
2	The objectives of the operation under study are constantly updated	5	4	3	2	1
3	The constraint/ constraints that prevent the achievement of objectives are identified	5	4	3	2	1
4	It is ensured that the limitation / restrictions are avoided	5	4	3	2	1
5	It is ensured that the process is working properly	5	4	3	2	1
6	It is ensured that the process is being exploited in the correct way	5	4	3	2	1
7	processes that are related to the Constraint/Constraints are improved	5	4	3	2	1
8	The enterprise is improving the efficiency of the process	5	4	3	2	1
9	The most appropriate solution to get rid of the restriction/restrictions is agreed upon	5	4	3	2	1
10	The above process is repeated as often as necessary	5	4	3	2	1
11	The company faces constraints in the process of supplying raw materials	5	4	3	2	1
12	The company faces constraints in providing manpower	5	4	3	2	1
13	The company faces restrictions in the process of storing finished goods	5	4	3	2	1
14	The company faces constraints in the process of storing raw materials	5	4	3	2	1

15	The company faces restrictions in marketing its products	5	4	3	2	1

Section four: Integrating DMAIC Methodology with TOC

Please indicate the degree of your agreement with each of the following statements:

		V.B.D	B.D	M.D	W.D	V.W.D
1	The problem and expected constraints are identified	5	4	3	2	1
2	Opportunities for improvement are identified according to expected constraints	5	4	3	2	1
3	Measuring tools are chosen so that they are suitable for measuring the output according to the expected constraints	5	4	3	2	1
4	An investigation is being conducted to find out the reasons for the detected constraints	5	4	3	2	1
5	The optimal solution to the deviations is found according to the constraints that have been identified	5	4	3	2	1
6	The solution for deviations and limitations discovered is documented	5	4	3	2	1

Please write any comments or suggestions you have

Questions ended, with my sincere thanks and appreciation to you,

Isra' Dasoqe

Appendix (C): List of arbitrators' names for the questionnaire

arbitrators' names	University
Dr. Sharif M. Abu Karsh	Arab American University
Dr. Yahia Saleh Salahat	An-Najah National University
Dr. Raed Ali Iriqat	Arab American University
Dr. Ahmad Herzallah	Al-Quds Open University
Dr.Mohammad Tawfiq Hasan Abusharbeh	Arab American University
Mr. Fadi Asedih	An-Najah National University

Appendix (D): Correlation tables:

D.1: correlation coefficient for each item in DMAIC implementation

DMAIC Methodology	Pearson Correlation
The problem faced by the organization is precisely defined	.483**
Available improvement opportunities are identified	.558**
Possibilities that may lead to product improvement are identified	.603**
Scope of work is defined for product improvement projects	.612**
Work is prioritized to improve products	.564**
Vulnerabilities are identified for operations	.517**
the strengths of the operations are identified	.501**
Define phase	.781**
Process performance measurement tools are identified	.718**
Usually measuring instruments are suitable for the purpose they are measuring	.683**
The performance level of the operations in the organization is determined	.602**
Objectives are set in harmony with the mission of the organization.	.676**
The goals set are measurable	.606**
Objectives that are set related to the process to be improved	.658**
Measure phase	.864**
Possible reasons for the deviation are analyzed	.596**
The main reasons for the deviation are analyzed	.561**
Negative deviation is analyzed according to the objectives set	.650**
Positive deviation is analyzed according to the stated goals	.441**
The institution is conducting an investigation of the causes of deviation	.610**
The institution analyzes deviations statistically	.394**
The main reasons are proven by the data	.689**
Analyze phase	.846**
The institution determines the causes of deviations	.625**
An optimal solution is found for the identified deviations	.652**
The suitability of the solution is tested before it is applied	.594**
The solution is selected according to the expected process performance	.724**
The solution is chosen according to the cost principle	.274**
The solution is chosen according to the demands of the operations	.553**
The solution is chosen according to the expected risks	.536**
Operations are improved by studying the operational risks faced by the organization	.542**
Improve phase	.847**
The optimal solution for deviations is applied according to the plan	.499**
The solution is being followed up	.630**
Improvements are proven	.655**
Measurement systems efficiency is analyzed	.653**
Processes are documented according to the expected outputs	.719**
Work mechanisms are defined to control new ways of working after improvement	.734**
The responsible person is determined to follow up on quality deviations	.672**

It is ensured that the adjustments made are documented	.674**
Control phase	.857**

D.2: correlation coefficient for each item in TOC implementation

TOC	Pearson Correlation
The objectives of the process under study are defined	.486**
The objectives of the operation under study are constantly updated	.390**
The constraint/ constraints that prevent the achievement of objectives are identified	.509**
It is ensured that the limitation / restrictions are avoided	.538**
It is ensured that the process is working properly	.612**
It is ensured that the process is being exploited in the correct way	.667**
processes that are related to the Constraint/Constraints are improved	.569**
The enterprise is improving the efficiency of the process	.539**
The most appropriate solution to get rid of the restriction/restrictions is agreed upon	.542**
The above process is repeated as often as necessary	.660**
The company faces constraints in the process of supplying raw materials	.387**
The company faces constraints in providing manpower	.467**
The company faces restrictions in the process of storing finished goods	.384**
The company faces constraints in the process of storing raw materials	.351**
The company faces restrictions in marketing its products	.375**

**. Correlation is significant at the 0.01 level (2-tailed).

D.3: correlation coefficient for each item in integrating DMAIC &TOC

DMAIC with TOC	**Pearson Correlation**
The problem and expected constraints are identified	.776**
Opportunities for improvement are identified according to expected constraints	.828**
Measuring tools are chosen so that they are suitable for measuring the output according to the expected constraints	.725**
An investigation is being conducted to find out the reasons for the detected constraints	.865**
The optimal solution to the deviations is found according to the constraints that have been identified	.812**
The solution for deviations and limitations discovered is documented	.818**

**. Correlation is significant at the 0.01 level (2-tailed).

D.4: Correlations coefficient for the questionnaire axes

		Define phase	Measure phase	Analyze phase	Improve phase	Control phase	DMAIC Methodology	TOC	DMAIC
Define phase	Pearson Correlation	1	.558**	.559**	.653**	.530**	.781**	.344**	.609**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000
	N	110	110	110	110	110	110	110	110
Measure phase	Pearson Correlation	.558**	1	.701**	.642**	.725**	.864**	.509**	.662**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000
	N	110	110	110	110	110	110	110	110
Analyze phase	Pearson Correlation	.559**	.701**	1	.627**	.654**	.846**	.386**	.631**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000
	N	110	110	110	110	110	110	110	110
Improve phase	Pearson Correlation	.653**	.642**	.627**	1	.655**	.847**	.516**	.640**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000
	N	110	110	110	110	110	110	110	110
Control phase	Pearson Correlation	.530**	.725**	.654**	.655**	1	.857**	.582**	.770**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000
	N	110	110	110	110	110	110	110	110
DMAIC Methodology	Pearson Correlation	.781**	.864**	.846**	.847**	.857**	1	.559**	.792**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000
	N	110	110	110	110	110	110	110	110
TOC	Pearson Correlation	.344**	.509**	.386**	.516**	.582**	.559**	1	.485**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		.000
	N	110	110	110	110	110	110	110	110
DMAIC	Pearson Correlation	.609**	.662**	.631**	.640**	.770**	.792**	.485**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	
	N	110	110	110	110	110	110	110	110

**. Correlation is significant at the 0.01 level (2-tailed).

الملخص

أجريت هذه الدراسة لمعرفة ما إذا كان دمج منهجية DMAIC و ونظرية القيود يؤثر بشكل إيجابي على تحسين جودة مصانع مستحضرات التجميل في فلسطين.

استخدمت الدراسة طرقًا مختلطة تم من خلالها جمع البيانات من خلال الأساليب الكمية والنوعية لاستكشاف وجهات نظر 110 مستجيبين من 22 مصنعًا لمستحضرات التجميل كانوا مجتمع الدراسة. لم يكن هناك حجم للعينة حيث أن الباحثة هدفت إلى دراسة جميع مجتمع الدراسة. لتحقيق أهداف البحث واختبار الفرضيات ؛ تم تقييم وتحليل البيانات من الاستبيانات باستخدام البرنامج الإحصائي(SPSS.21.0)

توصلت نتائج الدراسة إلى مجموعة متنوعة من الاستنتاجات أبرزها وجود علاقة قوية بين منهجية DMAIC و TOC مما يؤدي إلى تحسين جودة المخرجات عند تطبيق التكامل فيما بينها. كما تطبق بعض شركات تصنيع مستحضرات التجميل في فلسطين بطريقة بسيطة التكامل بين منهجية DMAIC و TOC ، حيث تحدد المشكلات التي تواجهها والقيود المفروضة عليها ؛ كما تحدد فرص التحسين والقيود المتوقعة أثناء التنفيذ باتباع خطوات منهجية DMAIC وبعض خطوات نظرية القيود. ، يمكن لـ TOC توفير الوقت والجهد والمال عند الإدارة مع ضرورات القياس وأهداف تحسين الكفاءة ، وتمكين المؤسسات من خدمة جميع الشركاء بسهولة أكبر . كما و أوصت الدراسة بضرورة ترسيخ وتعميق واستخدام الدمج بين النظرية والمنهجية في مصانع مستحضرات التجميل في فلسطين لتحسين الاداء وجودة المخرجات

الكلمة المفتاحية: منهجية DMAIC ، ستة سيجما ، نظرية القيود ، مستحضرات التجميل ، التحسين المستمر.