*J*FTH
Vol. 19, Issue 1 (2022)
ISSN: 2314-7024
E-ISSN: 2682-2180

The Role of Six Sigma Implementation in the Egyptian Travel and Tourism Industry, Case Study: Borg El Arab Airport in Alexandria, Egypt

Salma El-Manhaly
Lecturer – Tourism Studies Department
Faculty of Tourism and Hotels, Alexandria University, Egypt

Heba Said
Associate Professor– Tourism Studies Department
Faculty of Tourism and Hotels, Alexandria University, Egypt

Hala Hilaly
Professor – Tourism Studies Department
Faculty of Tourism and Hotels, Alexandria University, Egypt

Abstract

The implementation of the six sigma(6σ) methodology has been used to solve problems in many service organizations. It focuses on the quality of the products and services to fulfill the client's needs and expectations with affordable costs and defect rates. Despite its high ability to improve the organizations' performance, the literature about its role in tourism studies is still suffering from a lack of research, airports sector is not an exception. The implementation of 6σ in airports might be very effective in realizing high-quality levels and creating competitive advantages because it helps airports' management to identify their quality level and to improve their performance by reducing process defects. Further, it helps in achieving long-term financial benefits. The study suggests 6σ implementation(DMAIC) realizes a high level of quality of provided services at Borg El Arab Airport in Alexandria, Egypt (HBE). The study helps the travel and tourism organizations in determining the steps that maximize customer satisfaction and their performance level.

Keywords: Six Sigma , DMAIC , DFSS , Defect , Performance .

Introduction

Six Sigma(6σ) is a Statistical metric of the service or product quality level, depending on integrating all the organization's capabilities, collecting data and information about defects and errors in the organization's performance, analyzing it to get the radical solutions of the problems. It focuses on cost-efficient quick outputs that realize satisfaction. It aims to reduce the number of defects in manufacturing or services to 3.4 defects per million opportunities (DPMO) achieve an advanced level of performance and realize relative perfection, which increases the organization's market share" (Park, 2003; Mehrabi, 2012; Harry & Schroeder, 2005;

Dudien & Musaidah, 2014; Bañuelas & Antony, 2003; Reidenbach & Goeke, 2007).

6σ approach has been used in Motorola, Since the 1980s, it was adopted by several corporations in various fields both production and services, which differs in its application depending on the type of organization that applies it. Therefore, studies have presented various approaches to define it, as a quality metric, a statistical concept, a management strategy, an initiative, and a methodology of improvement. (Park, 2003; Mehrabi, 2012; Harry & Schroeder, 2005; Dudien & Musaidah, 2014; Bañuelas & Antony, 2003; Reidenbach & Goeke, 2007)

Despite the high ability of 6 σ to improve the organizations' performance, the services sector is still exploring the potential of using it in quality management and improvements implementation; The tourism sector is not an exception. (Syltevik et al., 2018).

As quality in the aviation industry generally and in airports, in particular, is a high priority, the implementation of 6σ in this field might be very effective in realizing high-quality level and creating competitive advantages because 6σ helps airports management to identify their quality level, compare it with their competitors, improve operational efficiency and realize service quality by providing a complete tool of best practices, that can help in reducing process defects and improving performance. Further, it helps in achieving long-term financial benefits(Garaham & AL-Muhareb, 2014; Syltevik et al., 2018).

The study suggests the implementation of 6σ to realize a high level of quality in Borg El Arab Airport in Alexandria, Egypt (HBE). The airport is located 43 km southwest of Alexandria, it provides air travel and freight services to Alexandria and the neighboring governorates as it is the hub passengers' airport on the northern coast. It plays a crucial role in developing tourism in the Egyptian western region (Helmy, 2018; Sayad & Morsy, 2019; VTT Technical Research Centre of Finland, 2015; Egyptian Holding Company for Airports and Air Navigation & Egyptian Airport Company, 2012).

Despite its importance, HBE airport performance is not compatible with the important role it plays. This deficiency is reflected through the negative reviews of the airport on social media, especially the pages specialized in tourism and travel, and on the official site of HBE airport. Consequently, this study aims to suggest an improvement plan for the airport based on reducing defects in the provided services performance by identifying the root cause of passengers' dissatisfaction and suggesting the procedures that could resolve them through the implementation of the 6σ methodology.

Theoretical framework.

6σ approach is implemented through two methodologies to achieve the desired improvement:

Design For Six Sigma(DFSS):

It is used when the processes of the organization could not satisfy customers' needs, the organization becomes incapable to achieve its objectives, so, the organization tends to implement this methodology as a preventive method to design new processes for preparing new products and services (Hu et al., 2004; Hanna et al., 2011).

Some studies suggest that DFSS can transfer the organization to a higher level of sigma, and its implementation saves a lot of time and effort to the organization rather than the need to improve an actual defective design (Al-Sabbagh, 2014, p: 151).

Define– Measure – Analyze- Improve – Control " DMAIC" Methodology.

it consists of making improvements to solve existing problems determined based on the voice of customer(VOC), and the critical to quality (CTQ) elements to get the required sigma quality level(SQL), and then achieve the desired goals (Al-Sabbagh, 2014). This methodology consists of three phases (Mansour, 2018):

Phase 1 "Before improvement project phase": it's about setting the infrastructure necessary for the improvement project. It consists of a single step called "Recognize (R)", which is the basis of choosing the idea of the project's improvement in accordance with the strategic goals of the organization by the 6σ consultant and the CEO (Ali, 2016). It includes data collection of the internal and external environment of the organization to prepare the process Flowchart and measure the current sigma level to evaluate the current situation of the organization and its effect on the Accepted Level of Quality (ALQ), in order to choose the appropriate sigma improvement project (Mansour, 2018).

Phase 2: the improvement phase consists of five steps that represent the (DMAIC).

- "Define- D": this step starts with the collecting of the VOC, either of the internal or the external customer of the organization, to define the CTQ elements (Al-Shaman, 2005), like reliability, delivery time, and quick response (Goda, 2013, p: 17).

Then, the team prepares the SIPOC diagram (Goda, 2013), to determine the following: (Mishra et al., 2014):

- "**S**" Suppliers: who provide raw materials, or other resources like information or products that are needed for the process.

- "**I**" Inputs: they are the items that are used through the process

- "**P**" Process: that converts inputs to outputs.

- "**O**" Outputs: it is the process's final product

- "**C**" Customers: who are the parties that receive the outputs, such as persons, groups, or processes.

- "Measure- M": by this step the performance or the sigma level of the current process are measured (Setter, 2018; Ali, 2016, p:25), to define the Voice Of Process(VOP), but before getting started, it is a must to set a clear data collection plan and ensure the reliability and accuracy of the existing measurement system Analysis (MSA). (Mansour, 2017; Ali, 2016; Eckes, 2003; Al-sharefee, 2012).

Then a **Composite Structure** is drawn to identify the sources of waste which consists of five other maps, as follows: High-Level Process Map, Value Stream Map, Distance Map, Throughput Map, and Precedence Map (Abbas & Shalash, 2015; Mansour, 2017).

- "Analyze- A": it aims to characterize the possible root causes of the problem by identifying its dimensions. (Ali, 2016; Ali, 2011; Raifsnider & Kurt, 2004). This could be done by comparing the Upper and Lower specification limits (USL – LSL) that are identified by the VOC, and the VOP, which are transferred to Upper and Lower (UCL-LCL) control limits by using the Minitab program, then a control chart drawn depending on the sort of the sample, which is collected in the measuring step, and the product or the service that represent the process. This chart enables the teamwork to determine the dimensions of the problem, to calculate the process capability (Mansour, 2017). It is intended to measure the ability of the process to meet its specific requirements, by using the capability indicators. The most common of these indicators are the CpK, which is calculated according to the following equation (McCarty et al., 2004):

$$CpK = \min \{CPU , CPL \}$$

Afterwards the root causes of the problem should be identified using the cause and effect diagram, the 5 why's tool, or the Pareto analysis (McCarty et al., 2004; Banawi, 2013; Goda, 2013).

- "Improve – I": the 6 σ teamwork uses brainstorming to develop a set of possible alternative solutions, which will improve the performance according to the previous analysis (Setter, 2018; Ali, 2016). The best solution is chosen after making a cost-benefit analysis, then the alternative is tested both financially then technically through a pilot run framework, by using the Failure Mood and Effect Analysis (FMEA) to discover the problems that can occur if it applied (Eckes, 2003; Tang et al., 2006; Mansour, 2017). Then the 6σ team implements the chosen solution considering a continuous control to achieve the desired response in the future or to get the ALQ of the product or the service (Al-Sabbagh, 2014; Raisinghani et al., 2005).

- "Control- C": In this step, monitoring plans are developed and implemented, in order to ensure that the improvement project changes have led to improving the performance, in addition, to ensuring continuity of these improvements (Ali, 2016; Goda, 2013).

Phase 3: the sustainability phase (post-project). This phase involves two steps that guarantee continuous improvement efforts, as follows:

– "Standardize – S": by reaching this step, the organization has established an expert system through the 6σ improvement project. Hence, the efforts can be maintained, and all 6σ concepts and methods could be a continuous and multifunctional approach to management. Within the framework of this expert system, the work is carried out to ensure the standardization of the circulation of knowledge in the organization (Park, 2003; Mansour, 2017).

- "Integrate- I": It intends to apply and integrate knowledge within the organization into a stable and long-term management system, where the 6σ establishes key linkage in the business management system, and this is done through:

- Implementing ongoing measures and procedures to guarantee continuous improvement.
- Publishing the success stories achieved by the organization.
- List the failures that took place with reference to the efforts and the partial success achieved within it. (Maleyeff & Campus, 2007; Park, 2003; Mansour, 2017).

Methodology.

The aim of the study.

The main aim of this research is to present the role of the 6σ methodology (RDMAICSI) to enhance the performance of the provided services of HBE, thus by determining the root causes of the defects that affect the satisfaction level of the airports' travelers.

Research methods.

This study used the problem-solving methodology (RDMAICSI) of 6σ to improve the actual processes and its outputs by reducing the variation and improving the quality level of the current processes via the imperceptible improvement (Perry, 2005; Usman, 2006). Further, The implementation of this methodology was through conducting several quality tools and statistical methods were used such as Sigma Calculator, Yield, DPU, DPO, DPMO, Pareto analysis, Control charts, SIPOC diagram, and statistical software programs like Minitab and SPSS.

- Semi-structured interviews were conducted with four employees working in both airport management and operating airlines.

- Online Observation at the airport to determine its service's attributes, which is needed to implement the Recognize phase.

- A Questionnaire was designed according to the previous studies of (Airport Cooperative Research Program et al., 2009; Wiredja et al., 2015) within the framework of applying the 6σ (RDMAICSI) methodology. The questionnaire was covered six key dimensions of airport service quality, each dimension includes several attributes, which were about 29 attributes. This questionnaire was electronically distributed during October 2018, to passengers who have already traveled through Borg El Arab International Airport in the Arab Republic of Egypt, based on random sampling technique, it reached 361 responses. The questionnaire was tested through a pilot study conducted in November 2017 for two weeks, and it was about 102 responses.

- Using the questionnaire analysis to implementation of the improvement phase (second phase) of the methodology, which needed to get a random sample from travelers for the third time in order to ask them about the time required to end their travel procedures at the airport, to complete the remaining steps of the improvement phase.

The implementation of 6σ methodology at the Borg El Arab International Airport, Alexandria(HBE)

Phase One: **"Recognize - R**" step:

This phase is the pre-project phase, it identifies the sigma level of the service quality and the airport's performance. Through evaluating the level of airport services and investigating travelers' feedback about the problems they encountered during their travel through the airport.

This phase was implemented through online observation which helped to identify the service process provided at the airport as shown in figure 1

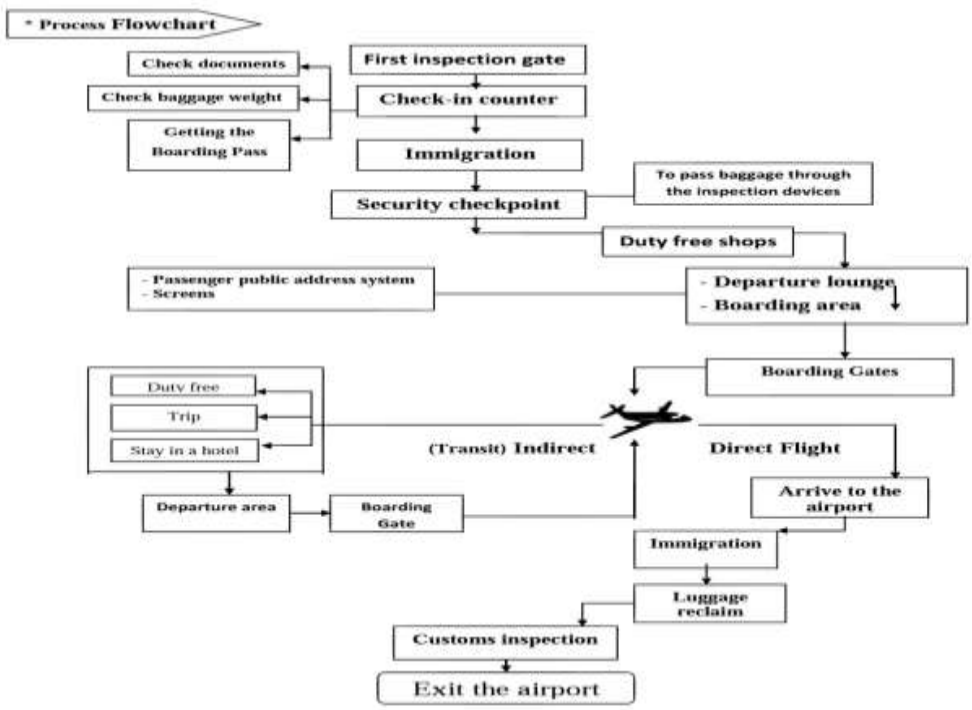


Figure 1 Flowchart of service delivery process at HBE Airport

The questionnaire was used to identify passenger's feedback. The respondents selected the element which represents an error/ defect at their recent experience with the airport service attributes within the research period.

Table 1 Analysis of the results of the features of airport services components

Statement	Frequencies
Airport Access	
Ground transportation access to and from the airport	**174**
Walking distance to the gates	**140**
Clarity of airport terminal signs and symbols	**101**
The Convenience of Flight Information Display(Clarity/quality of information)	**115**
Airport Service and Facilities	
Processing time at check-in	**182**
Queuing systems and seating	**135**
Internet/Wi-Fi accessibility	**163**
Comforts of seats in the gate waiting area	**123**
Variety of concession outlets	**167**
Waiting time at baggage claim	**88**
Lost baggage services	**101**
Availability of luggage trolleys	**71**
Standards of disabled access and facilities	**89**
ATM facilities	**85**
TV and Entertainment facilities	**106**
Car parking service facilities	**146**
Airport Cafes & Restaurants facilities	
Availability of nationally recognized restaurants chain	**139**
Choice of cafes and restaurants	**142**
Cleanliness of the café or restaurant outlet	**118**
Prices charged in cafes and restaurants	**201**
Airport Shopping Facilities	
Availability of nationally known retail outlets	**136**
Variety of retail outlets	**148**
Value of price of goods or services at the retail outlets	**207**
Airport Service Personnel and Security	
Courtesy/attitude of airport staff	**190**
Language skills for airport staff	**156**
Waiting / Processing time at the security checkpoint	**244**
Airport Environment	
Overall cleanliness of the airport(Terminal cleanliness, Floors, Seating and Public areas)	**186**
Overall interior settings and layout of the airport	**159**
Friendliness of airport staff	**164**
Total	**4176**

The following conclusions can be drawn:

Failure Opportunities (O) = 29 (Failure Opportunities reflect the total number of attributes that represent the service provided by the Borg El Arab International Airport)

Units (U) "respondents" = 361

Defects (D) = 4176 – (which chosen by the respondents)

- This data was used to calculate Sigma level as follows:

- Defects Per Units (DPU) = D / U = 4176 / 361 = 11.56786

- Defects Per Opportunities (DPO) = DPU / O

= 11.56786/ 29 = 0.39889197

- Defects Per Million Opportunities = DPO × 1000000

=0.39889197× 1000000

= 398 892

- Sigma Calculator was used to calculate the sigma level and the Yield of the service delivery process at the airport, and the results were as follows:

- Process Sigma Level = 1.756
- Yield = 60.11 %

This means that the service at the HBE airport operates at a 1.75 sigma level, (the number of defects reaches over 400000 defects per million services.)

Further, airport attributes were tested by Pareto analysis to identify the attributes that have the greatest relative weight as a defect, which is used to determine the critical improvement project that should be adopted, as shown in figure 2

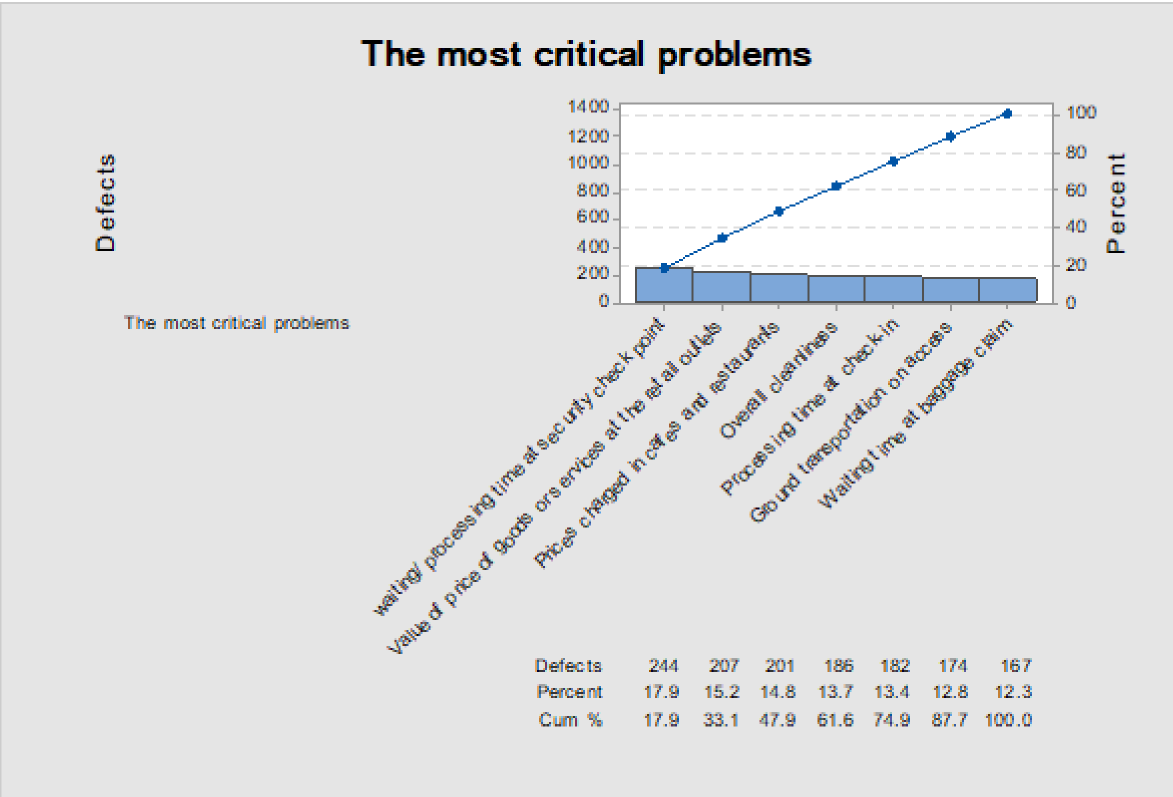


Figure 2 The Pareto analysis of travelers frequencies.

As shown in figure 3 Three problems related to the waiting and processing time at a security checkpoint by 244 frequencies, processing time at check-in by 182 frequencies, and finally, waiting time at baggage claim by 167 frequencies. Two Price-related problems were the high value of the price of goods and services at the retail outlets by 207 frequencies, followed by prices charged in cafes and restaurants by 201 frequencies.- The overall cleanliness at the airport by 186 frequencies.- Finally, the ground transportation access to and from the airport by 174 frequencies. The previous results showed that the second phase in the RDMAICSI of 6σ should target the long-cycle time needed to complete the travel procedures.

3.3.2. Phase two: "the improvement phase", consists of five steps(DMAIC):

3.3.2.1 The Define (D) started with preparing the SIPOC diagram.

Suppliers	Inputs	process	Outputs	Customers
- Engineering Authority of the airport and those who deals with it. 1- Equipments and tools suppliers. 2- Maintenance companies. * Ministry of Interior (Ports Security service)to ensure security and inspection. * Airlines * Food and beverage suppliers to airlines. * Restaurants & cafes and Shops. * Banks. * Cleaning companies. * Airport staff. * Passengers	* Equipment and tools: -Inspection gates. - Computers. - Advertising screens. - Guiding boards. - Devices for checking baggage weight. - Inspection devices for goods and baggage. - Seats. - Counters and its equipments (papers – printers – pens…etc). - Baggage trolleys. - ATM Facilities. - Disabled facilities. * Software Systems: (Passenger public address system – Ticketing systems) - Airplane and auxiliary equipment such as the elevator. - Airport and airlines staff. - documents required(Passport-medical and Security Clearance.. etc) - and any others devices needed for completing the process	Arrive at the airport ↓ First inspection gate ↓ Check-in counter ↓ Check documents ↓ Check baggage weight ↓ Getting the Boarding Pass ↓ Immigration ↓ Security checkpoint ↓ Duty Free shops ↓ Departure area ↓ Boarding area ↓ Plane ↓ Arrive at the airport ↓ Immigration ↓ Baggage Reclaim ↓ Customs inspection ↓ Exit the airport	- Transportation service: (passenger – baggage) - a lot of papers and reports from the airport throughout the process . - Trip file.	- passengers - Airport Administration - Airline staff.

Figure 3 SIPOC diagram for the process of service delivery at HBE Airport.

The VOC showed that the Upper Specification Limit (USL) (the time required to finish the travel procedures) which satisfies the customer according to the International Civil Aviation Organization (ICAO) must not exceed an hour.

The measure (M) began with collecting a random sample of the airport passengers electronically to measure the total time required to finish the travel procedures at the airport (Total Cycle Time). The sample size was 200 passengers, in accordance with the requirements of ACI.

To verify the sample's validity, the study calculated the following:

Mode = 45

Mean $(\overline{X}) = 46.92$

Median = 45.

And then we calculate ..

mean/median = 1.042667≫104.27 %

mode/mean = 0.959079≫95.91 %

mode/median = 1≫100.00 %

It is clear from the previous results it is between 95%: 105% which verify the validity and consistency of the sample.

- Standard deviation (σ) = 20.82576.
- The **Composite Structure** is drawn for identifying waste, and it consists of*:

- **High-level process map**: represented in the inputs, processes, and outputs, and illustrated in figure 4 in longitudinal columns which exist at the bottom of the three terms,

- Value Stream Map: consists of two maps,

.. Waiting time: It is the time required to wait between each step and other

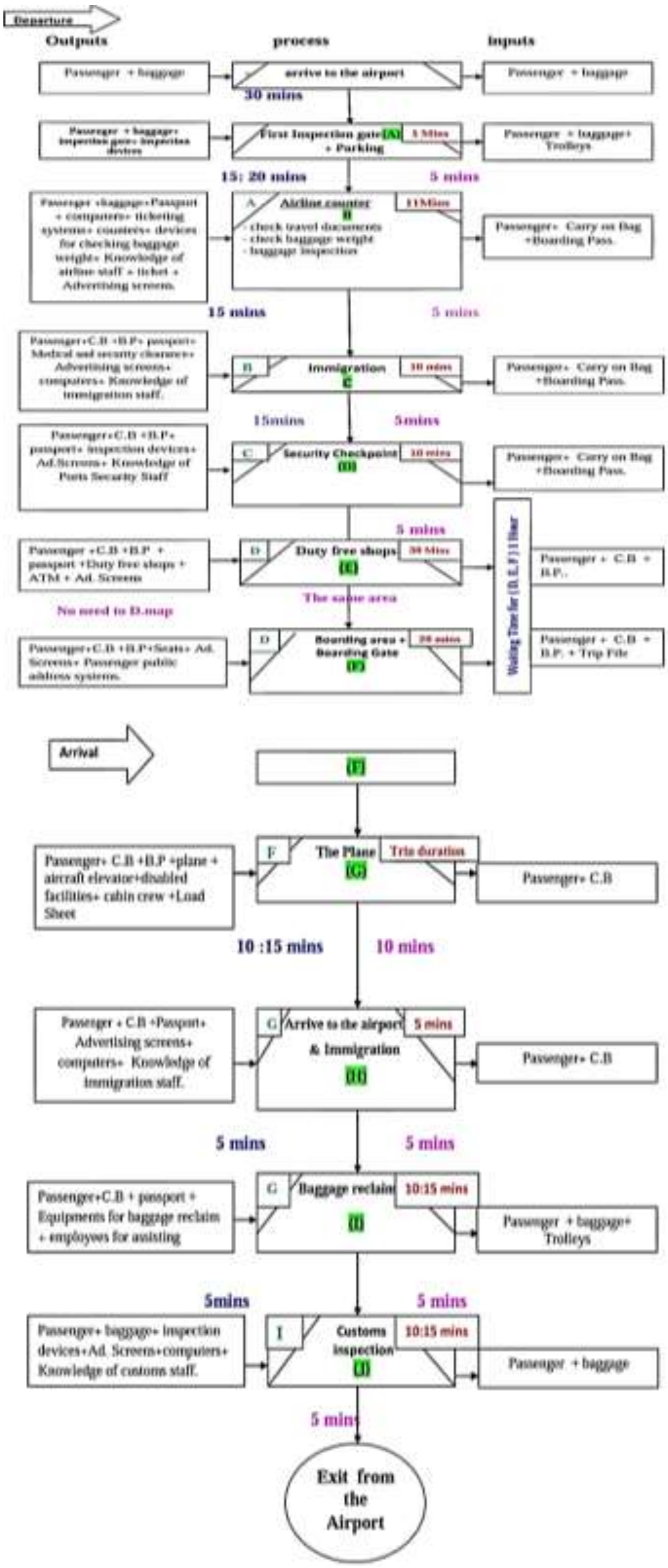
.. Touching time: The actual time needed to perform each process.

- Distance map: this map clarifies the time needed to move between each step and the other.

- Precedence map: to determine which processes that depend on the performance of what proceeded by processes of.

(each one of the previous maps is shown in figure 4 with the same written color.

Figure 4 Composite Structure for the process of



travel services delivery and the access to HBE airport

*The data specified in this structure was based on the online observation and the interview data with Mr. Ziad Khaled Antar from Aero Service Egypt.

Analyzing (A) The limits that the process can reach by the conversion of the voice of process (VOP) to Upper Control Limit (UCL), and Lower Control Limit (LCL). This is done by drawing the suitable control chart to the type of the sample by using Minitab. The study used the "**I Chart** " as it suits the numerical nature of the sample's data, and as the sample has been pulled once (Mansour, 2018).

The limits that the process performance can reach, are as follow:

UCL = 109.1 , LCL = - 15.2

Measuring(M) the Process Capability :

Cpk = min { CPU , CPL}

As mentioned previously, and according to ICAO requirements the process has only the upper specification limit (USL), So the equation would be as follows:

Cpk= CPU

$$Cpk= \frac{USL-\overline{X}}{3\,\sigma} = \frac{60-46.9}{3\,X\,20.82576} = \frac{13.1}{62.47728} = \mathbf{0.20967}$$

Based on the process capability indicators∴
The process capability is weak.

And therefore the process is not capable to achieve customer satisfaction and this is due to the value of CpK= 0.21 which is less than 1.

The Previous data can be grouped into Process Capability Six Pack Report, to illustrate the stability of the process and the distribution of data under the normal distribution curve and to clarify the deviations.

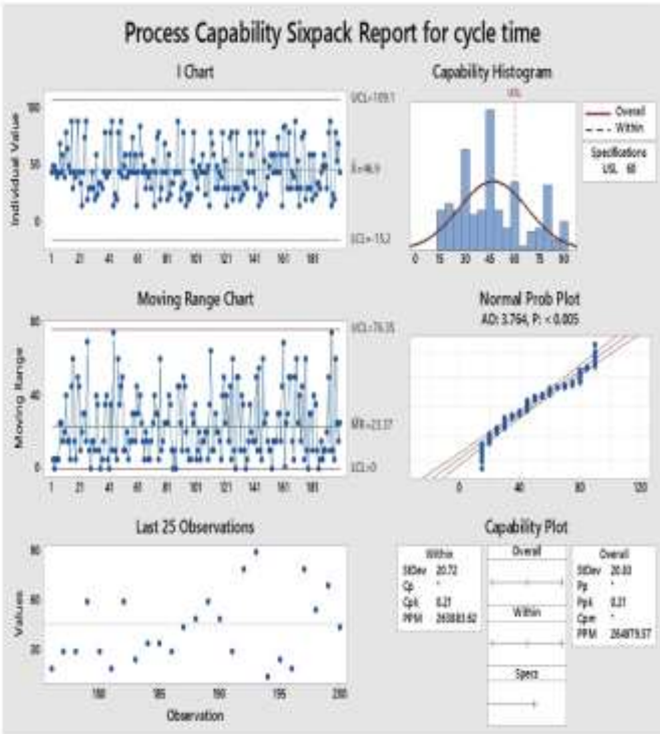


Figure 5 Process Capability Sixpack Report for cycle time

The I Chart reflected the time period spent by each passenger to end the travel procedures, with the mean x̄ of the CpK, as well as the Upper Control Limit (UCL), and the Lower Control Limit (LCL), which the process can reach.

The Moving Range $\overline{MR}$ demonstrates the difference in time between each passenger and the other to finish the travel procedures. Figure 5 shows that the performance of the process tends to be erratic and there isn't a consistent performance.

UCL = 76.35 , LCL = 0.

- **Last 25 Observations** diagram showed the large variation between the observations. This is evident in the last 10 readings, which means there is a large variation in the process.

- Further figure 5 Showed that the data obtained from the sample are distributed under the normal distribution curve except for some of them which are beyond the curve, which means that there are several radical problems that affect the time period required for the completion of travel procedures at the airport, which will be clarified, verified and analyzed through the cause and effect diagram.

- the **Normal Probability Plot** represented the data in a single linear direction, which indicates the reliability and validity of the data. But some points appear outside the linear direction, indicating the radical problems that have also emerged in the previous histogram.

-**Capability Plot:** this figure demonstrates the measurements of the process capability, as stated previously this process has a one-sided operation limit, so PpK = CpK = 0.21, as previously calculated, therefore the process is not capable because the CpK is less than 1. The specs clarified the upper specification limit, which is 60 mins.

To get the root causes of the problem the following tools have been used:

A- The cause and effect diagram, as in figure 6

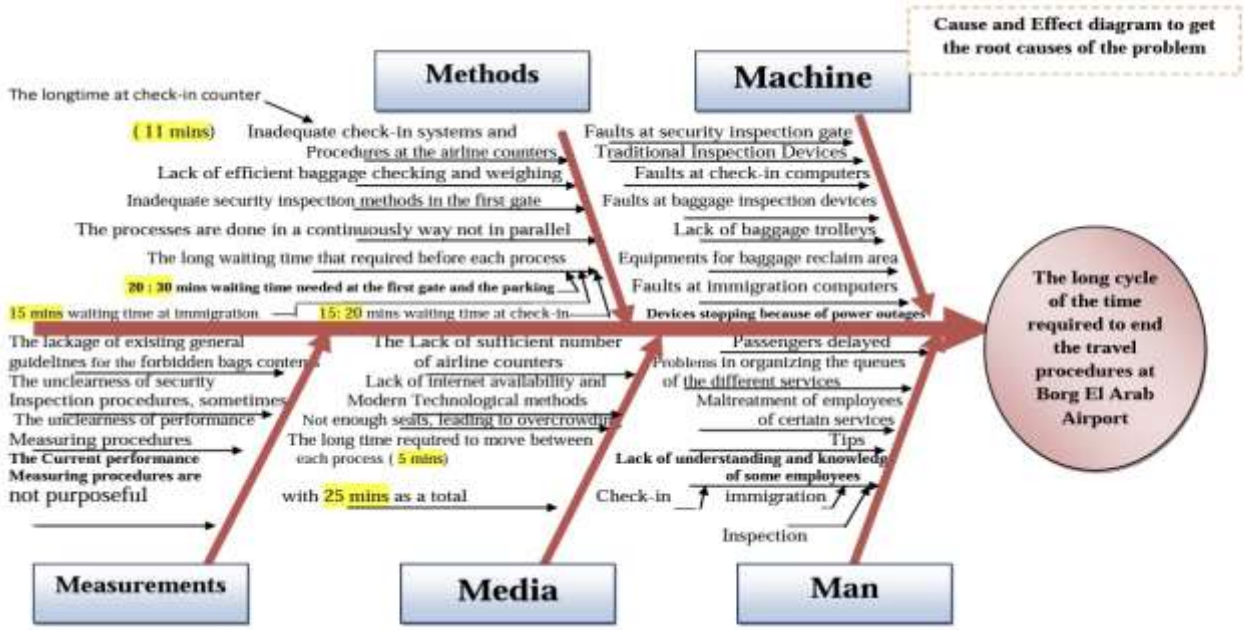


Figure 6 Cause and Effect Diagram to get the causes of the problem

B- The 5 why's tool has been used to help in developing a solution.

Table 2 The 5 why's analysis of the root causes of the problem of the long cycle time of time required for ending the procedures of travel at HBE airport

The main problem	Customer dissatisfaction because of the long time required to complete the travel procedures	
Problem's level	Why?	Due to the length of waiting time before each process.
	Why?	Because of the length of touching time required to complete each process with each traveler.
	Why?	Due to the inefficiency of the provider of each process.
	Why?	the lack of the servicing role provided by the airport to support their efficiency.
	Why?	The ineffectiveness of the role of quality management at the airport.

Improve (I): after reaching the main reasons for the long time required to complete the travel procedures, the Improve(I) step was to put an improvement proposal was represented in figure 7.

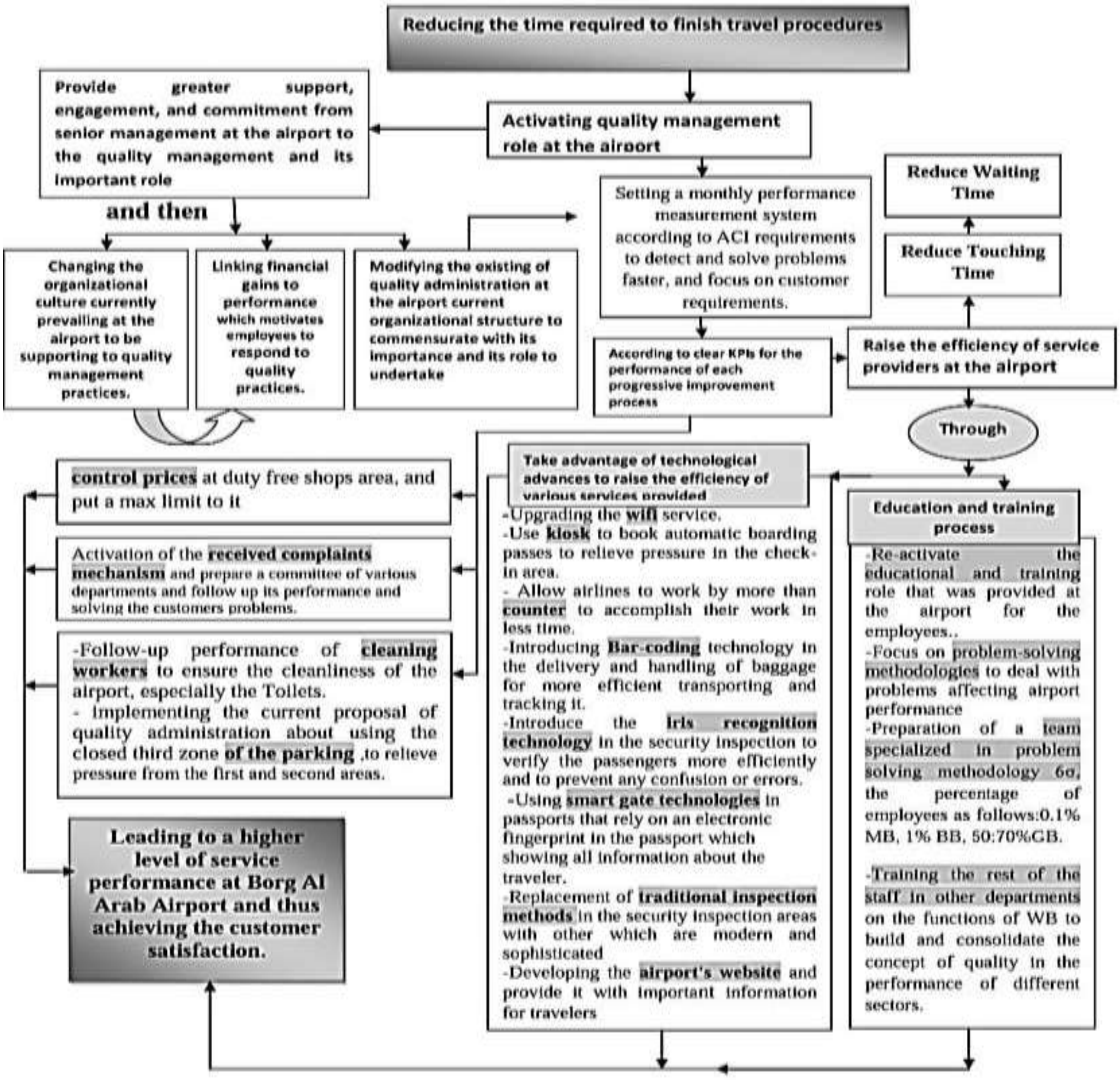


Figure 7 The improvement plan of HBE airport performance in Alexandria

Control (C) plan was suggested to monitor the implementation of the internal processes to avoid performance deviations. The internal control included monitoring the performance of the previous improvement, maintenance and breakdowns, assets control, and staff performance. While monitoring the external customers included monitoring the critical specifications to customers and the changes that may occur, taking into consideration the normal specifications of customers, as well as monitoring and following up all that is happening at the other Egyptian airports, both in terms of their operational and financial performance**.**

- **The control plan for the 6σ project** is then developed to improve the performance of HBE airport in Alexandria, as shown in the following table 3:

Table 3 The control plan for the 6σ project for HBE airport

	Process	Specs (Max-Min)	Inputs	Outputs	Measurement Techniques	Sample size	Sample Frequency	Analytic tool	Corrective action
1	Check - in	The maximum extent permitted is 6mins per row, which consisting of 10 people	Airline employee+ Passenger+ Baggage+ Ticketing systems+ Passport+ Ticket+ Devices for checking baggage weight + more than 2 counters + Kiosks	passenger+ Carryon bag+ Boarding Pass	online observation to a random sample of passengers	200 passengers	once a month	I-Chart by using statistical analysis program (MiniTab)	Adjust the performance of the employee based on the prescribed specification
2	Security check point	The maximum extent permitted is 10mins per row, which consisting of 10 people	Passenger+ C.b+ B.P+ Passport+ Knowledge and Skills of inspection employee+ inspection devices+ Iris recognition device.	Passenger+ B.P+C.b	online observation to a random sample of passengers	100 passengers	once a month	I-Chart by using statistical analysis program (MiniTab)	Adjust the performance of the employee based on the prescribed specification
3	Immigration	The maximum extent permitted is 10mins per row, which consisting of 10 people	Passenger+ C.b+ B.P+ Passport+ Security and medical clearance + computers+ Knowledge and Skills of immigration employee+ electronic gate	Passenger+ B.P+C.b	online observation to a random sample of passengers	100 passengers	once a month	I-Chart by using statistical analysis program (MiniTab)	Adjust the performance of the employee based on the prescribed specification
4	First inspection gate+ parking	The maximum extent permitted is 10mins per row, which consisting of 10 people	Passenger+ Baggage+ Inspection gate+ new inspection devices.	Passenger+ Baggage+ Trolleys	online observation to a random sample of passengers	100 passengers	once a month	I-Chart by using statistical analysis program (MiniTab)	Adjust the performance of the employee based on the prescribed specification
5	Baggage reclaim	The maximum extent permitted per row, which consisting of 10 people is differ based on the type of the aircraft: - 45 mins for type E. - 30 mins for type D. - 20 mins for type C.	Passenger+ C.b+ Passport+ Baggage reclaim area equipments + 22 conveyor belt + assistant staff for passengers.	Passenger+ Baggage+ Trolleys	online observation to a random sample of passengers	100 passengers	once a month	I-Chart by using statistical analysis program (MiniTab)	Adjust the performance of the employee based on the prescribed specification

The third phase "Sustainability phase" should be implemented by the improvement team under the supervision of the quality management with the participation and support of high management in HBE airport and with the cooperation of all those who are working in the airport to standardize between the old and modern processes of improvement and integrate it into all the operations' airport.

Findings

The implementation of the 6 σ DMAIC methodology showed that the sigma level of services in HBE airport was 1.7, with several defects that exceeded 400 thousand defects per million service provided, the study recognized the most frequent problems as the waiting and processing time at the security checkpoint, Processing time at check-in,- waiting time at baggage claim. The Pareto analysis showed that the **long cycle time** at the airport is the main problem that must be prioritized in the improvement project.

The study suggested an improvement project applying the DMAIC methodology and suggested the development of an experts system to improve airport performance and integrate this experts system into all airport processes.

Conclusion and recommendation

Six Sigma could be used to realize a high level of quality in HBE airport through a more accurate way to target real defects, and making an improvement plan that is based on a number of accurate statistical methods and quality tools that realize accuracy in defining the right steps to be made to solve the problem and suggesting a whole improvement plan and future procedures ensure the successful implementation of the improvement plan. The study showed that the improvement process in HBE airport should start by solving the long cycle time problem as a starting point of launching a continual improvement 6σ process to enhance passengers' satisfaction through a series of sub-improvement projects aiming to enhance the services' quality of performance in the airport.

On the other hand,the Ministry of Aviation should focus on improving the quality of the service provided to achieve the satisfaction of current customers. As for the Egyptian Airports Company (EAC) should alter its training policy practices on quality methodologies from just training on the ISO 9001: 2015 standards, to the 6σ methodology by training the airport staff according to the different belts through establishing educational and training partnerships with the specialized national and international agencies accredited to learn 6σ, as well as participating in the 6σ courses which tailored and organized by IATA, to provide the airport with the human resource necessary to lead an effective quality control that helps improving its services and raise its competitiveness.

Future studies

Should be made to spot the other defects in the airport and suggest improvement plan to it using the six sigma methodology.

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