Optimization of Business processes in Airport Services Company in Macedonia using the TQM Philosophy

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Abstract **–This study is to show a full diagnostic to some of the business processes in the company for airport services in Macedonia was made. The methodology of TQM (Total Quality Management) system was applied in the company, especially in the sector for de-icing and protection against frost on aircrafts. With the implementation of this system, an optimal solution was found for uninterrupted operation in the airport traffic. In this way there was a change in the company paradigm – do not work hard but smart, with a constant improvement of processes, while taking into account the needs and desires of customers and profit. This research shows that other methods and techniques were applied such as Pareto Diagram, Ishikawa approach, Checklist, Map of trends, all in order to identify problems and find an optimal solution.**

Keywords **–Total Quality Management (TQM), Quality improvement, flowchart, Pareto diagram, Ishikawa approach, checklist**

1. Introduction

The new quality strategy called integrated quality management or total quality management (TQM), answers the following questions: What do the customers want? What should be done? Which processes should be used?

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To realize the methodology of TQM in airport services means to make a progress in all parts of the processes, or in other words to accomplish services through realization without errors [1]. The adoption of this philosophy implies a full commitment of the management on the way to perfection focusing on passengers and work; adaptability towards the requirements and satisfaction of passengers, employees, the airport concessionaire, and the wider community. TQM philosophy differs from other philosophies primarily because of the following [2] [3]:

- focus on fulfilling the wishes and the needs of passengers and all other users of the airport services;
- change in the management approach with fundamental change in their paradigm - do not work hard but smart; and
- providing a fast return of investments.

In Macedonia, very few companies give importance to the significance and the benefits of the implementation on this type of work. The reason for this might be the poor education of young managers as well as the lack of a quality management team. Currently this philosophy has been adopted only in foreign investment companies including telecommunications, banks, insurance companies or large domestic companies in need to place their products in the European Union and other countries. All of them, in order to be more competitive in quality and price of products or services, must meet certain standards, build a compact enterprise where the role of teams and managers will be of significant importance on the way to success [4].

The company for airport services in Macedonia in the past years is advancing at high speed, transforming itself into a major regional brand. The main company activity is aimed at airport services, transport, and logistics. The majority of the

company's activities, are with an emphasis in the sectors where dominates the transport logistics, treatment of employees, customers and the creation of business culture to the satisfaction of all interested parties. The change in the ownership structure within the company created a need for designing a system of total quality management in response to the customer requirements and changes inside and outside the organization. The airport services are services provided to aircrafts, passengers and their luggage, cargos, goods etc. Generally, these are services that are provided everywhere in the world in all international and domestic airports, but they differ in the processes, the quality and the time needed for completion. The care for the traveller begins with their entrance at the airport building and ends when the passenger enters the aircraft. With the implementation of a bus line to the airport, the service expands from the moment when the passenger enters the bus from the city to the airport.

The decision of the management of the company for airport services to adopt the TQM strategy is the right way on the path to excellence. In that sense, the following model is proposed - an integrated methodology for successful design and implementation of TQM in the company's system for airport services, which gave solid results in their implementation. In practice, the model proved to be universal, applicable to all companies regardless of which activity is being performed [5]. The benefits obtained from the implementation of this model will lead to increased efficiency and productivity of the companies and their sustainable development, Fig. 1.

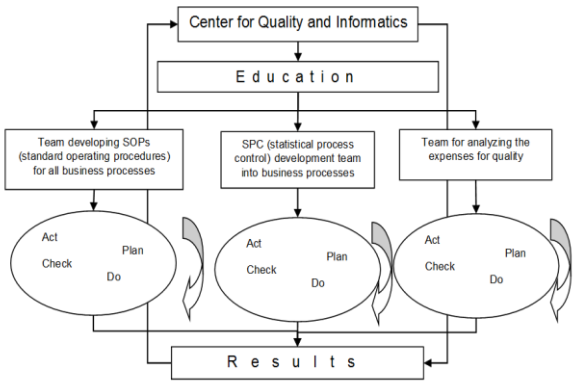

Figure 1. Model - an integrated methodology for the successful design and implementation of TQM system in companies

The TQM strategy based on this model means integration of information technology with internal standardization, methods and techniques for flawless operation, cost optimization as well as education and motivation for employees in which team spirit is present [6]. The foundation in the creation of this model is the redesign or reengineering of the business processes, afterwards it begins with a new phase in the business operation - continuous improvement or turning the Deming's quality circle (Plan-Do-Check-Act). The model can be applied after the assertion of the actual company's condition, when all the anomalies in business operation will be confirmed through diagnostic or determination of the existing situation and strive to continually improve the quality of overall operations [5].

The success in the design and implementation of TQM system can be achieved only if the business processes are designed and implemented with the optimal use of resources in order the work to be best completed from the first time without defects, without time loss and to the satisfaction of all users [7][8]. In order to achieve this goal, a selection of teams to design each of the subsystem is needed. Building management teams is accomplished through involving, authorizing and encouraging the managers to design each of the subsystem in TQM system and achieve effective dialogue with the employees [4]. This way will allow preventing possible defects, eliminating problems and removing possible causes on time. The usual resistance and fear of change quickly surpass and a strong desire to change the existing situation imposed with a new approach for quality with full commitment towards customers, employees, environment and the state.

2. Subject of research and analysis

The subject of this research is the company that provides airport services in Macedonia with diagnostic on the internal operation and integration with the external environment. The survey was conducted by identifying the existing business processes in the company, diagnostic and analysis of all anomalies in the operation, appeals and complaints from the customers, and determination in the core of the realization of the activities. The analysis of the current situation in the airport services company enabled new proposals for service advancement through the application of TQM methodology in every function [5][9][10][11][12]. For this research the methodology for improving business processes were applied through several steps.

The course of research realization is as follows:

- ***Step 1: Initiative for doing a project to improve the business process of de-icing and protection against frost on aircrafts.***

The Diagnostic as a method and technique creates a useful habit among employees towards solving problems and improving the quality, but not towards

getting quick solutions. For the managers, the diagnostic should be a normal standard procedure that will quickly respond in solving problems, and it will increase efficiency and effectiveness in managing business processes.

For the airport company, the need to offer better services to the end-users imposed reviewing the business process of de-icing the aircraft and optimization of the same process in order to shorten the time for service delivery to the satisfaction of all interested parties. For the airport company the most important is to have no delays in the airport services. With the start of the winter season, the vehicles for aircraft maintenance must be mobile and ready at any time for giving the de/anti-icing service. For managers the initiative for doing a project to improve the business process of de-icing and protection against frost on aircraft has become a priority.

- ***Step 2: Subject of interest – a problem that should be solved***.

The subject of interest can be many shortcomings such as defects (errors), delays, losses, impaired labour discipline, unstable business process, increasing the cost for quality, reduced productivity and other more. It is important how the problem will be set. Its formulation should follow a line diagram of comparing the planned and the actual condition. The business process of de-icing and protection against frost on aircraft in real terms is causing dissatisfaction among the airline companies due to loss of time, loss in terms of delays, penalties, dissatisfaction among passengers and so on.

De-icing the aircraft is a procedure that removes the ice, snow and slush of aircraft's surfaces. Defrosting is done with a special fluid for de-icing called ADF - chemical used for de-icing and protection against the frost on the surface of the aircraft. ***After the de-icing process follows the process of protection against frost on the aircraft through a procedure that protects*** it from the additional layers of ice, snow and slush. The procedure for de-icing and protection against frost on the aircraft is performed by using special vehicles for that purpose (FMS LMD-2000). When using the vehicle, the driver- VTO vehicle operator (heavy equipment driver) must comply with the instructions for vehicle use issued by the vehicle manufacturer. The standard operational procedure of the business process of de-icing and protection against the frost on aircraft is carried out as follows on Fig. 2.

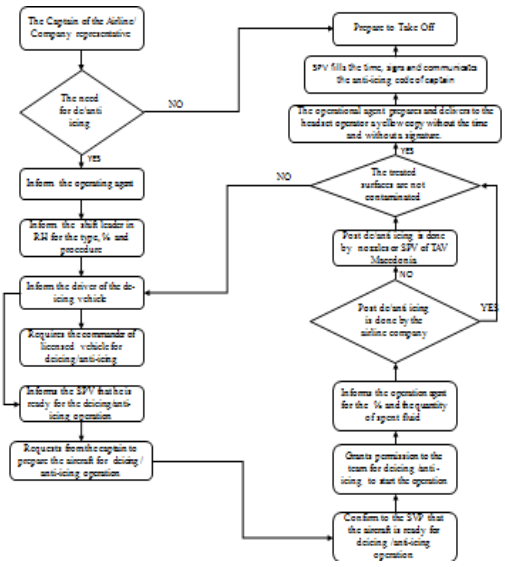

Figure 2. Standard operating procedure of the business process of icing and de-icing of the aircraft

The drivers (VTO) are obliged on a daily base to monitor the supply of vehicles with ADF fluid and water, their heat and the technical road worthiness of the vehicles. When a notice for the de-icing service is given, the driver (BTO) is obliged to heat the water and ADF fluid and the nozzles to be prepared with protective equipment. The type of ADF fluid used must meet the criteria prescribed by the AEA and ISO 11075, Aircraft - De-icing / anti-icing fluids, ISO type I and ISO 11078, Aircraft - De-icing / anti-icing fluids, ISO types II, III and IV. In table 2 are given the regulations regarding the estimated time to protect the aircraft from freezing.

Table 2. Expected time to protect the aircraft from freezing (Hold overtime)

Air temperature, outside	Mix of ADF and water	Weather Conditions	
C°	Type IV /water %	snow	Icy rain
-3 C° and lower	100/0	0:35-1:25	0:25-0:40
	75/25	0:20-0:55	0:15-0:30
	50/50	0:05-0:15	0:05-0:10
Under -3 C° to -14 C°	100/0	0:20-0:40	0:10-0:25
	75/25	0:15-0:35	0:10-0:20
Under -14 C° to -25 C°	100/0	0:15-0:30	No icy rain

Table 3. Checklist which represents the biggest problems in the services of protection against the frosting of aircrafts for the duration of six months

	Delays (errors in the process) / months (2014/2015)	11	12	01	02	03	04
Airport Alexander the Great, Skopje	Delay due to the distance from the base station	///	///	///		/	//
	Delay due to lack of equipment	/	//		//	//	/
	Delay due to insufficient training of the operators	/	///		//		/
	Delay due to equipment failure	//		//		//	/
	Frustration due to the low quality of service	/	//	//	/		

The diagnostic of problems in this process was made by a competent team that concluded the following:

The one responsible for the flight (the operating agent) notes that the plane did not take off on time, by confirming the delay code that the delay was due to certain reasons afterwards registering them in the checklist.

In the first case, the team leader notes that the car for defrosting and protection did not come in time (after the call), thus precious minutes are lost which means a lot for the air travel industry, as a reason for the delay the distance from the base station has been stated.

A second problem arises in the process of heating the mixture (water and fluid ADF), which should have a constant temperature (65°C). The procedure is performed with a torch, which the vehicle possesses, that in many occasions is dysfunctional.

The third problem occurs in the base station where the stocks of ADF fluid are stored, due to its outdated technology. In an occasion when there is a need to supply the ADF fluid, the operators do the supply mechanically, thus wasting a lot of time.

The fourth problem are the outdated vehicles in which repeatedly occur errors in the ratio - water: ADF fluid (which ratio must be 100% accurate), and in case of a failure the procedure for de-icing and protection must be repeated.

The fifth problem is the inadequate performance of the standard operating procedure due to insufficiently trained personnel.

- **Step 3: Collecting and data analysis- determining the difficulty of the problem by applying adequate methods.**

The collection and data analysis is the foundation to identify the cause of the problem. There are three essential methods and techniques of quality: stratification, graphics display, and study of deviations. Stratification answers the questions: who, what, where, to whom and what went wrong. The problems that arise are recorded on checklists, and they are mostly because of the DE-ICING procedure in winter. By collecting all the data analysis, the biggest problems during the four weeks were examined as mentioned below, Table 3.

Based on the checklist a Pareto diagram was designed from where the key issues can be seen and a fast action can be taken. Once the problem is detected it is continually measured in its depth and critical activity based on the collected database information, Fig. 3.

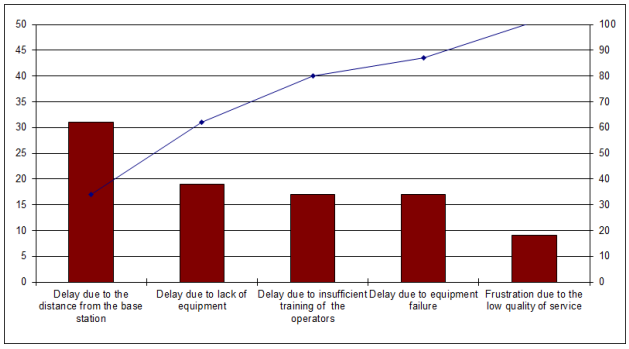

Figure 3. The biggest problems in business operations in the process of de-icing and protection against frost on the aircraft

In particular intervals the critical operations are measured, whether they are within the given norms of AHM (Airport handling manual). If AHM clearly specifies the time for this type of service, and it is not respected by the team who delivers the service, the responsibility will fall to the leader (controller / supervisor), and the company must pay fines, penalties. Following are the losses in time in terms of servicing the aircraft in the process of its de-icing and protection against frost.

The first problem - the distance from the base station to the runway leading to loss of time (5 to 10 minutes) for intervention, arrival to the aircraft.

The second problem - heated water, daily takes more than 30 minutes to heat the water.

The third problem - the outdated technology or lack of hot fluid at any moment can take more than 3 hours, and in circumstances where there is more air

traffic and the weather conditions are bad, it comes to a complete congestion.

The fourth problem is associated with the extremely high expenses for the company in terms of repeating the procedure when errors in mixing ratio water: ADF fluid (which ratio must be 100% accurate) appear, and in case of failure the procedures must be repeated for defrost and protection.

The fifth problem is associated with the poor training provided to the staff leading to a waste of time even more than 5 to 10 minutes per operation. Any delays in relation to the operations are recorded in the daily report by the agent - the leader at the end of the working operation. All involved in the business process, all leaders of teams do their own checklist. These checklists record any delay in the timely execution of the defrosting operation and protection of aircraft. To take corrective measures need to find the reasons first.

- **Step 4: Analysis of the causes of problems - identification of the main cause of the problem.**

For the analysis about the causes of the problems in the present process a clear standard operating procedure (SOP) is used, which provides detailed analysis of all the causes of the problem. The procedure involves formation of a diagram of causes and consequences - Ishikawa approach. The problem is being examined further by using different methodologies such as 4M (Man, Machine, Method, Material), 4P (People, Plant, Policies, Procedures) and others. Statistically, the analyses of the causes of the problems are followed by their frequency and how to annul them using the tools such as Pareto diagram and Ishikawa diagram. These tools help the managers to prepare the statistical data based on check lists from the supervisor, Fig. 4.

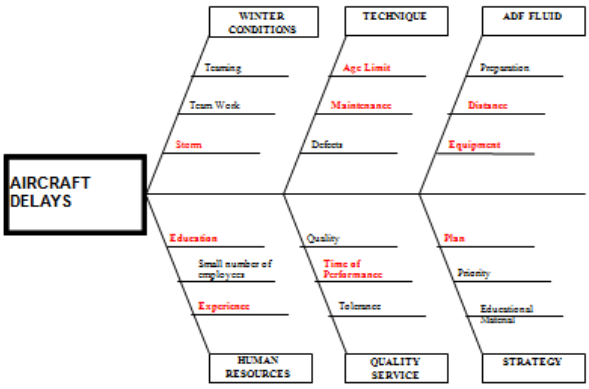

Figure 4. Ishikawa diagram to analyse the causes of problems in the business process of de-icing and protection against the frost on the aircraft

With the Ishikawa diagram managers can recognize the cause - effect relationships problems. In the first problem - the delay of the defrosting car is due to the distance of the base station from the aircraft. The analysis of the second problem showed that heating the water on the vehicle itself is expensive or it requires daily more than 40 liters of oil and 30 minutes more time for heating the mixture of ADF and water. The analysis of the third problem shows that outdated technology in the base station is a serious problem because there is no option for heating a certain stock of ADF fluid and water. For the fourth problem the analysis showed that the age structure of the vehicles is the main cause for repeating the process of de-icing and protection against the frost on the aircraft. The analysis of the fifth problem or the insufficient vocational training to individuals is leading to loss of time from 5 to 10 minutes per operation. The proposal of the management team is to implement some solutions to overcome the problem.

- **Step 5: Selecting a solution for improvement and establishment of the improvement plan.**

If the root cause is found then the solution is clear, it should eliminate the cause. If the problem is unsolvable, it should be solved by reengineering of the business processes. Reengineering of processes can bring the risk of new problems, while the local solution (by separating and removing the key cause) is a solution that does not destabilize the system. With a local solution (redesign) alternative solutions are sought which quickly and with minimal cost remove the causes of the problems. The team suggested the following solutions to correct or find a new solution to eliminate the causes of the problems, which may include short-term management project for improvement and implementation:

The possible solution to the first problem would be a new location for the base station, which will be near the new platform and the arrival time of the defrosting car for protection against frost will be kept to a minimum.

A possible solution to the second problem would be to purchase an instantaneous water heater that will be connected directly with the vehicle's tank and maintain constant temperature of the fluid and water up to 65 °C. This solution is designed to reduce the expenses and the time needed to heat the tank, in the same time there will always be a hot fluid and water.

A possible solution to the third problem would be to purchase a new base station with modern technology, which will supply hot fluid and water at all times.

Table 4. A checklist for the biggest problems at the service during the six months (2015)- measurements made after the introduction of the corrective measures

	DELAYS (errors in the process)/ months (2015)	06	07	08	09	10	11
AIRPORT	Delay due to the distance from the base station						
	Delay due to lack of equipment	/			/	/	/
	Delay due to insufficient training of the operators	/	/		/		/
	Delay due to equipment failure	/		/		/	/
	Frustration due to the low quality of service	/	/	/	/		

A possible solution for the fourth problem would be to purchase new vehicles with modern technology, which will drastically reduce the recurrent operations.

A possible solution for the fifth problem would be to continuously educate the employees. The company's education center should continue with trainings and learn from the other airports' mistakes, by gaining a new knowledge about the latest developments in the field of legislation and technology. In this way the four work principles were meet: fast (on time), quality and secure (safe) operation, satisfaction of employees and passengers, strengthening the corporate image of the company and profitable work.

- **Step 6: implementation of the solution.**

For implementation of the solution the most important control points are:

- whether employees who need to use the solution have accepted the planned solution;
- whether the solution has been checked;
- whether a prompt feedback has been received;
- whether undesirable side effects occur which outweigh the benefits of the proposal.

Proposing and implementing the solution gives an answer to the question whether the solution solved the problem or not. By installing an instantaneous water heater, the expenses were drastically reduced. An analysis was done on the expenses in terms of oil and electricity consumption for a period of four weeks and the following results were gathered. The installation of a new boiler brought a savings of 42.000,00 denars per month. The total investment for installation of the boiler is 43,260.00 denars, which means that funds invested in the tank are returned within one month. With this advancement, despite the savings, the service has constantly ready fluid and water (65°C) and can intervene at any time, thereby eliminating airplane delays. The Pareto diagram before and after the proposed corrective measures confirms the elimination of the key cause.

- **Step 7: Evaluation of effects – verification of the solution.**

The evaluation of effects goes in the following direction: Is the confidence that the problem is solved gained? What is confirmation that the problem is solved? Were all the knowledge and benefits used during the work on the solution? Quality control monitors the advancement on the processes, whether the taken measures contributed to the errors elimination. The checklist is followed up again as well as whether the frequency of errors is removed and if other irregularities occur as a result of steps taken. The results are visible, there is reduced number of errors whereas the delays of this delay code (de-icing-anti-icing) are almost rare, Table 4.

We should not evaluate only the direct results of the solution. It is important to assess other features such as: the increased customer satisfaction and staff as well as the improved organizational climate. In assessing the effects of advancement, the following was concluded:

- ✓ By relocating the base station and finding the appropriate location the delay due to the remote distance of the station was minimized.
- ✓ The advancement in the process with the heated water and fluid (ADF) proved to be the ideal solution to this problem that eliminated the delay in aircraft operation due to the failure of the equipment.
- ✓ The purchase of a new base station made the airport to be included among world-class airport, as a modern airport providing better services.
- ✓ The purchase of new sophisticated vehicles leads the repetition of procedures for de-icing and protection against frost of aircraft to be reduced to zero, or in other words the new technologies give a lasting solution to this problem.
- ✓ Education and training of employees raised their level of knowledge about service delivery which was rated as excellent by the users of the airport services.

From this we can conclude that the implementation of the model achieves the given goals, that is, the increase of customer satisfaction by 70% and by

which we can conclude that there has been a significant progress. After the evaluation, the verification of the solution into a permanent solution was confirmed.

- **Step 8: Standardizing the solution into a permanent solution.**

The standardization is not an easy and simple operation. One solution to be standardized requires showing all the facts that confirm that the proposed solution (the new SOP) is satisfying.

- **Step 9: Closing the project for improvement and validation of the identified problem as well as the response to new problems.**

The reflection on the process is identified by answering the following questions:

- ✓ which difficulties occurred during the process of the advancement, whether they are clearly understood or not;
- ✓ is there a clear picture which part of the process to be upgraded in the next attempt;
- ✓ are the results confirmed and understood (achievements) and in what the benefits of the advancement are seen;
- ✓ is there an interest between the teams and the employees for further improvement;
- ✓ Are the team members trained on the steps, methods and techniques of quality management?

3. Conclusion

This methodology is supported by the Deming's (PDCA) cycle which gives the answer to the following questions: how it works and what needs to be done to improve the quality of services [5]. By using this methodology to the following was achieved:

- ✓ the motivation and commitment increased dramatically since the work was divided equally to everyone;
- ✓ the teamwork strengthened, all employees worked together as one entity;
- ✓ the business cooperation with airlines has grown into a partnership and the instalment of a new software program, the airlines companies can receive accurate information and quality services to the satisfaction of everyone;
- ✓ after the measurements done and the second survey on the users of the airport service it was found that their satisfaction increased for 55% and complaints on the time required for servicing the devices were reduced from 49 to 19;
- ✓ with multiple trainings for the employees their coordination increased and errors decreased (form 18 errors cases due to insufficient education and trainings for the employees they decreased to 2);
- ✓ the practice to improve the quality of the whole company is spread;
- ✓ the achievements of employees are recognized;
- ✓ habits are acquired for improving the quality practice–the diagnostics;
- ✓ the solutions are standardized;
- ✓ the legitimacy on the conclusions are ensured.

The requirements for high quality products/services require not only a purchase of new equipment, but also investment in education and training of employees, reengineering on the business processes and permanent improvement on the quality system [13]. The strong competition can be withstand only by those companies that are well organized, have a qualified working capital, are investing in education and training of employees, are investing in improving business processes and they are investing for organizations' innovations [14].

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