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An Initiative to Practice Total Quality Management in Aircraft Maintenance

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Abstract

An aircraft has an economic life of about 25 years. To remain in serviceable condition, regular checks and repairs are conducted. The frequency of such repair activities depends on the manufacturer's specification. As more repair and maintenance work is needed on ageing aircraft to ensure their continued airworthiness, more frequent overhauling of critical components is expected. Under this scenario, aerospace maintenance is set to become a significant business activity. Time to delivery and higher standards of service have become business imperatives in aerospace maintenance. The implications of a delay in maintenance are only too obvious. A lower quality of service is unacceptable as it compromises the safety of air travel. Current deregulation moves in the airline industry have further intensified competition, squeezing less cost-effective operators out of the industry. As maintenance costs form an integral part of the total operating costs, airlines are constantly sourcing for cost-effective and reliable repair houses. The criteria that an airline customer looks for in an efficient maintenance provider are quality of repair, short turn-time and competitive price. An aircraft repair facility that is able to provide high quality engineering service with a short turn-time and at competitive prices is highly sought after. To this end, application of Total Quality Management principles will prove useful.This paper describes the Total Quality Management implementation process in an aerospace maintenance company. Relatively simple total quality concepts and tools are discussed to improve the quality and cost of maintenance operation. Besides achieving the quality, intangible benefits of this attempt are also elucidated in this paper. Problems that may encounter

in implementing total quality management principle for aero maintenance sector are also overviewed.

Keywords: Aircraft, Maintenance, Airworthiness, Overhauling, Aerospace, Quality, Safety, Airline Industry, Cost-Effective, Total Quality Management.

1. Introduction

Around the world, aviation has succeeded in offering a quality service that is highly safe and affordable. However air operators have not been rewarded for the quality of their services. The airline industry is notorious for never having paid returns to its shareholders in the aggregate. The problem of the profitability of the industry needs to be urgently targeted. To achieve maximum effectiveness, the organisation must follow recognised international practices and maintain a system for the management of quality. Quality management is a coordinated activity to direct and control an organisation with regard to quality. Aviation equipment such as aircraft demands utmost safety and reliability during service use, and hence, the normal requirements may not suffice. Certain additional industry-specific requirements are mandatory. These include, requirements in the areas of reliability, maintainability, and safety; airworthiness requirements, such as design verification and validation, etc. Emphasis needs to be given in areas such as configuration management, accountability for quality controls, first article inspection, measurement of key characteristics, etc. Scope for continuous monitoring of the quality management system and taking steps to prevent/rectify occasional aberrations due to human error must be available.

Efforts to monitorand to ensure quality of aeronautical products are enormous due to thetechnological sophistication, the rigours of stringentpractices, and the spread of a large number ofassociated work-centres in the aviation sector. Itposes a significant challenge to the quality assurancefunctions in general, and the role of regulatoryauthority, in particular. The fact, that airworthiness,quality, reliability, and safety will have to be themajor selling points of aeronautical products, makesit a compulsory course to adopt, accept, and practicethese.For efficiency and profitability, airlines can benefit from an advanced form of quality management, total quality management (TQM). This tool goes well beyond satisfying the customer or offering quality products as required by ISO 9000.TQM is a quality approach in which all members of an organization participate in improving processes, products, services and the culture in which they work. Airlines can benefit from TQM because it is widely agreed that the industry needs cost reduction and control, without losing the focus on product safety.TQM emphasizes, among other things, eradicating defects and waste from operations, reducing development cycle times, reducing product and service costs, and challenging quantified goals and benchmarking.

2. The Interpretation of TQM Within the Aviation Industry

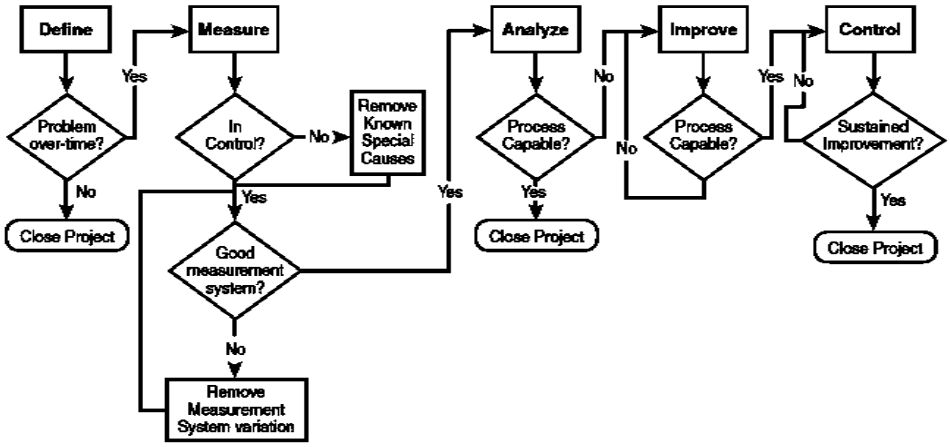
There is a strong argument that TQM principles are only applied to achieve the organization's goal i.e. to improve the economic performance of the company. This paper is based on the opinion that TQM principles can adequately bring a company's processes under statistical control and it can define a sustaining infrastructure of its implementation. With this knowledge of TQM, it is no surprise, that many aviation firms are implementing TQM principles in combination with other business strategies in a bid to achieve the enterprise set goals. TQM tool has been regarded as a successful system capable of achieving significant gains in business performance. Apart from the strength that it has in the focus on quality and the ability to more adequately bring an enterprise process under statistical analysis, many regard TQM tool as a business strategy while others refer to it as a well-structured and highly effective methodology that achieves improvements in product and process variation which in turn enhances operational performance. Companies such as Motorola and General Electric have implemented this TQM approach to great success and have based their Business-Process-Improvement and to good effect.

3. Six- Sigma

Six-Sigma in general is a fact-driven, disciplined and statistical approach that is followed to eliminate defects and guide processes to reach perfection. Being a versatile system in making business leadership perform better, Six-Sigma doesn't work based on any single theory/strategy. It is based on result driven strategies used in the past century and many important management ideas, which lead the way in today's competitive money making world. There is no one single definition for Six-Sigma. It is a statistical measure of performance of processes/products; a goal that reaches perfection for performance improvement; a management system to achieve business leadership and enhanced performance in a long run. In simple words, Six-Sigma combines best techniques of the recent past with the best management breakthroughs and common sense. Three main areas of Six-Sigma focus are customer satisfaction, reducing defects and eventually reducing cycle time. Team leader's commitment, usage of common language throughout the organization, processreengineering enforced by aggressive engineering goals, fact based decision making, good communications to keep the interest on Six-Sigma and its continuity on track and maintaining metrics to evaluate past performance and assess future goals are some of the key success factors of Six-Sigma. Six-Sigma is a management language that institutionalizes a precise, closely controlled, fact-based approach to deliver more money to the bottom line through process improvement and process design projects. These design projects are selectedby top management and led by highly trained Six-Sigma Black Belts or Master Black Belts with the intention to create ideal processes, products, and services all aligned to delivering what the customers want. From the above discussion it is clear that the management's commitment, which acts as the driving force for both breakthrough and traditional improvements, is very essential in

the journey towards successful implementation of Six Sigma methodology. In general mathematical terms Six-Sigma is the relationship of manufacturing variability and product specifications. In statistical terms, it means that no more than 3.4 DPMO (defects per million opportunities) is possible when a process is at a Six-Sigma level of performance. A defect can be defined as a measurable attribute of the process or its output that is not within the standard acceptable limits, i.e., not conforming to specifications. Customer focus, fact-driven management, process focus, down to business management, boundary-less group effort and drive for excellence are the six critical factors that are required for an organization to attain a quality level of Six-Sigma. The eventual purpose of Six-Sigma is to raise profits by getting rid of variability, discrepancies and wastes that weaken customer trustworthiness. Any organization like manufacturing, engineering, R&D, sales and marketing, health care and government agencies can utilize Six-Sigma for excellence in quality.

4. Proposed Methodology



The above flowchart illustrates the six sigma process using DMAIC which are explained as follows:

4.1 Define:

The team should the project with bird's eye view of the process also known as high level mapping. The classic tool for this process is SIPOC. Once the mapping is done, the key area for the project should be identified which can be done using FLOWCHART. The focus of the project is the customer of the process, which can be done by understanding the 'voice of the customer (QFD).

4.2 Measure:

Once the base line for the problem is identified, data collection should be carried out, which can be done by using DATA COLLECTION PLAN. Before that the root cause

for the problem should be found using CAUSE & EFFECT DIAGRAM. By testing and refining the measurements ensures the future corrective action is based on fact and data rather than assumptions and opinions.

4.3 Analysis:
Next process is to confirm the proposed root cause is creating the problem by verifying the data through the data analysis, process analysis and comparative analysis by using the tools PARETO CHART, HISTOGRAM & PROJECT CHARTER. The charter is used to add information so the accurate reflection of project will be obtained.

4.4 Improve:
BRAINSTORMING should be used to produce many ideas as possible which produce quality. In order to ensure the right decision is made, PDCA cycle is used. Accomplishing successful implementation requires careful planning, the more team time we spend on planning will reach the adaptation faster to the improvements.

4.5 Control:
In order to maintain the focus, we should narrow down the vital few measurements for the performance. At this point, we should update documentation. One of the powerful tool to increase the performance is BENCHMARKING the efforts applied in other areas in the organisation. The sharing of project success leads to greater momentum of change within the organisation. The six sigma drives more success.

4.6 Suggested tools for DMAIC

PROCESS	TOOLS
DEFINE	• SIPOC • Flow chart • QFD
MEASURE	• Cause & effect diagram • Data collection plan • CTQ
ANALYSIS	• Pareto chart • Cause & effect diagram • Histogram • Project charter
IMPROVE	• Brainstorming • PDCA • Design of experiments

CONTROL	• Control chart • Benchmarking • Documentation • Sigma calculation.

5. Conclusions

The TQM journey is a long and slow one, and the continuous improvements have to be made along the way. For example deming's [13] suggests that it takes 10 years to implement TQM fully. From observation, the TQM can be implemented in each stage for improvement. All personnel should undergo training on TQM tools for the continuous improvement. To sustain the improvement:

- Involve more employees
- Provide additional training
- Identify more areas for improvement
- Develop long term strategies to institutionalize the TQM process.

The tools for each process in maintenance of aircraft suggested will be helpful in the improvement of TQM culture in the organisation. It will be further proved by undergoing real time validation in any aero industries as our future project.

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