



**Quality and Safety management system in aeronautic maintenance  
organisation**

By

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## **Abstract**

Quality and safety management systems are mandatory from the enforcement of Part 145 air maintenance approval under Chicago convention annex 15 and 19 framework. This dissertation objective is to review the framework, requirement and module of ISO quality management system, AS supplement quality management system, maintenance organisation approvals, safety management system and safety culture. To assess integrated factor towards quality and safety under the framework of integrated quality safety management system. And to illustrate fulfilment of information flow between quality management system, supplement quality management system, safety management system and air maintenance organisation approval framework. The research has been conducted by utilising secondary researches data type by qualitative research method with thematic and content analysis from common search engine. Quality management system has been suggested by air maintenance approval to apply ISO 9001 and AS 9110 that possible to integrate to other ISO standards as ISO 45001 and ISO 14001 under ISO annex SL that systemise ISO standards into one quality system before integrated with safety management system, safety culture and air maintenance approval structure under integrated quality safety management system framework. Integrated framework leads quality and safety to fulfil each system missing gaps by flow quality and safety information under digitalised software that provide efficiency and effectiveness towards operation and management with structured guidance and accurate archive.

**Keywords:** Quality management system, Safety management system, Integrated Quality Safety Management System, Air maintenance organisation approval

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## **Glossary**

**AD** Airworthiness Directives

**AMC** Acceptable Means of Compliance

**AMEL** Aircraft Maintenance Engineer License

**AMM** Aircraft Maintenance Manual

**AMO** Air Maintenance Organisation

**ANSI** American National Standards Institute

**ANSP** Air Navigation Service Provider

**AOG** Aircraft On Ground

**ASR** Aviation Safety Reporting

**BER** Beyond Economical Repair

**CAA** Civil Aviation Authority

**CAT** Commercial Air Transport

**CD** Clearance Delivery

**CMM** Component Maintenance Manual

**CPA** Corrective Preventative Actions

**CRM** Customer Relationship management

**CRS** Certificate Release back to Service

**DOA** Design Organisation Approval

**EASA** European Aviation Safety Agency

**ERP** Enterprise Resources Planning

**FAA** Federal Aviation Administration

**GM** Guidance Material

**IAMS** Integrated Airline Management System

**IAQG** International Aerospace Quality Group

**IATA** International Air Transport Association

**ICAO** International Civil Aviation Organisation

**IQSMS** Integrated Quality Safety Management System

**ISMS** Integrated Safety Management System

**ISO** International Standard Organisation

**ISSO** Integrated Safety Service Organisation

**JAR** Joint Aviation Requirement

**MOE** Maintenance Organisation Exposition

**MRO** Maintenance Repair and Overhaul

**MTO** Management Team Operation meetings

**MTOE** Maintenance Training Organisation Exposition

**OEM** Original Equipment Manufacture

**OHSAS** Occupational Health and Safety Assessment Series

**OHSMS** Occupational Health and Safety Managmnet System

**OSR** Operational Suitability Report

**PDCA** Plan Do Check Act

**PMA** Part Manufacturing Approval

**QA** Quality Assurance

**QC** Quality Control

**QMS** Quality Management System

**SAE** Society of Automative Engineers

**SAG** Safety Action Group

**SAS** Safety system And labour health protection System

**SB** Service Bulletin

**SMS** Safety Management System

**SRB** Safety Review Board

**SRM** Safety Risk Management

**SRM** Structural Repair Manual

**STC** Supplement Type Certification

# Chapter 1

## Introduction

### 1.1 Motivation

Quality and safety has been circulated in humanity life for several decades from acceptance of sustainability, suitability, consistency, efficiency and effectiveness of the result of production that anticipated by customers and society from management by the carrier. Moreover, the systems continuously cultivates and solidates from loop holes that can be seen from the accidents and incidents where it can be guaranteed that the organisation must producing and managing in an acceptable path or process that has been structured within maintenance of the system and users of the systems themselves. On the other hand, the requirement of ICAO Manual on the Quality Management System for Aeronautical Information Service, Section 1.3.1 justified as “In addition to specifying the quality requirements for aeronautical data, Annex 15 requires state to introduce a quality system to implement quality management at each of the function stages of originating (or collecting), collating or assembling, editing, formatting, storing, publishing and distributing of aeronautical information. Annex 15 also recommends that this requirement be met by establishing a quality system that complies with ISO 9001”, International Civil Aviation Organisation, as well as Annex 19 Safety Management System. Which means that aeronautic maintenance organisation shall comply quality management system and safety management system that leads them towards recognition of customers and consumers in the market worldwide. For instance , it can be seen in the section 3.2.8, (Kenny, 2011) that nowadays there mobility of adaption and adaption of AS 9110 standards 42% globally or 24,084 organisations worldwide from January 2021 to February 2022. By gathering an updates, frameworks and requirements of the quality and safety management systems shall be a mobility to create an evidence of how safety management systems and quality management systems circulated in the aeronautic maintenance organisation nowadays.

### 1.2 Objective

Quality and safety are mandatory from the enforcement of Part 145 air maintenance approval under Chicago convention annex 15 and 19 framework. The aim of this dissertation is to explore and interpret IQSMS that form of ISO 9001, AS 9110, ISO 45001, safety management system and safety culture. The information can be conducted from the organisation, government and agency website that

enforcing, operating and consulting the system and framework by common search engine. The objective of this dissertation is to review the framework, requirement and module of ISO quality management system, AS supplement quality management system, maintenance organisation approvals, safety management system and safety culture. To assess the integrated factor towards quality and safety under the framework of integrated quality safety management system. And to illustrate efficiency and effectiveness of information flow between quality management system, supplement quality system and air maintenance organisation approval structure.

### **1.3 Outline**

This dissertation theme is quality and safety management system in an aeronautic maintenance organisation that aim to explore and interpret IQSMS that form of ISO 9001, AS 9110, ISO 45001, safety management system and safety culture. Nevertheless, the dissertation is form of 6 chapters and described as, chapter 01 is an introduction that contained motivation, objective, outline, methodology and general framework. Chapter 02 consisted of background and overview quality management system, supplement quality management system, safety management system as well as similarities, differences and relationship of mentioned system. Chapter 03 is the explanation and structure of Part 145, Part 66, Part 147, ISO 9000s and AS 9110. Chapter 04 is the explanation, structure and module of safety management system, safety culture, ISO 45001 and integrated quality safety management system. Chapter 05 is case study where the comparison and explanation between ISO 9001, AS 9110 and Part 145 module in fulfilling factor that structured in a form of ISO quality management system clauses. Chapter 06 is conclusion where conclusion of the dissertation, achievement and future work are found. Bibliography or references can be seen after chapter 06, which considered as the last part of the dissertation. In addition, acknowledgement, abstract, content, list of figure, list of table and glossary are in the first part of the dissertation before chapter 01.

### **1.4 Methodology**

This dissertation is a basic research that is aimed to cultivate the knowledge, theories and predictions that amplified the comprehension of the standards, approvals and certifications. Moreover, this research has been conducted by utilising secondary researches data type or existing data that collected by other author, organisation and publications, which approaching by qualitative research method that focusing on words and meaning. Nevertheless, thematic analysis has been selected to approach on gathered information from focused group, coding and examining each topic with the comprehension of the context of the knowledge within interpretation to connecting relevant point of the topic. Content analysis has been utilised in certain point of the dissertation as to review the communication and meaning of the

publications in order to reach to the point of the acknowledgements of the purpose, meaning and aim of the words, phrase or sentences before pursue above analysis methods to pursue a descriptive measurement as to measure or justify the direction of the dissertation from selected data as it is without controlling any variables. Furthermore, this dissertation was using common search engine from an internet such as google to explore to various sources of information, which the information gathered has standard on selecting publications, reviews and context. For instance, the information shall only be able to verified and authenticated or must be came from the specialised organisation, enterprise, carrier and government publications within licensed expertise. Therefore, it shall be validate to utilised into this dissertation, which correct method has been used for an intended outcome of resources that leads to an organised structure.

## **1.5 General framework**

Aviation operators or service providers are subjected to comply with legislation and regulation concerning safety management system within other management systems such as, quality management, security, occupational safety and environment protection. This requires correct balance to implement different management system in the organisation as well as comprehend and recognise possible conflict that may arise from diversified regulations. In addition, such conflict must solve internally, which if necessary, the conflict shall agree by regulators. As the result of it, regulations allow integration of various management systems into one complex management system. Which it is mandatory to implement suitable system to suitable situation that solves, improves and maintain the standard or goals of the applied system continuously that required structural implementation towards all levels that in charged. Since, safety risk management or SRM is a fundamental of SMS and is not a part of QMS but product realisation is a fundamental of QMS. In addition, SMS is concerned with safety towards operation and OHSMS is concerning on health safety of employees in the operation. By integrating and cooperating under the same platform by exchanging information between safety management systems and quality management systems benefiting in the operation and management of the carrier to be able to acknowledge and pursue continuously check-ups, evaluate, analyse and minimise operational and management risks to maximise opportunities towards the operation and management outcome.

Quality is considered as obligate to obey in all divisions, which uplifting value or features that anticipated by customer and consumers of the product or service that being processed by the carrier is the primary path of increasing its values in the existed market. Importantly that quality of the product or service referred to consistency and reliability of the result after the goods has been processed, which determined as safe to use by customer. In addition quality features reflexed to correct as planned operation of product or service launch that can be failed in any occurrence with predicted period of operation. Nevertheless, the systems defined as the set that cooperated during the schedule operation to

maintain effectiveness and efficiency of the structure. Therefore, as it is mandatory to maintain airworthiness of the aircraft by various systems to pursue the outcome of reliability, accuracy and quality of the performed task. In addition, aircraft airworthiness such as technical maintenance and inspection is a periodic process, which shall be accomplished with acceptable criteria or putting an aircraft on ground condition when task is remaining. On the other hand, to ensure and enhance the circulation of quality in the organisation, it shall be done by solidate various systems and approvals such as ISO 9001:2015, AS 9110, Part 145, Part 66, Part 147 and other relevant standards, certifications and approvals, which depending on the domestic, regional and international enforcement, market trend and customer satisfaction of the aircraft maintenance organisation. For example, quality management system is obtained in the organisation from world class recognition that minimise gaps and loop holes in diversify topics and focus as customer satisfaction. In addition, quality management is not only reflect the quality of the production from the carrier to be an exact outcome by manufacture that satisfied by customers and consumers but systemised documentation processes, procedures and platform used in the enterprise, which ease the performance of the organisation to maintain their sustainability of the consistency of management, production and movement of the carrier.

Safety management system that adopted in the same based or minimum standard such as Annex 19 SMS Chicago convention, ISO 45001 and other relevant standards, certifications and approvals, which depending on the domestic, regional and international enforcement that the aircraft maintenance, market trend and customer satisfaction of the aircraft maintenance organisation. Even though, the approval provide framework, structure and definitions of the safety management system but it is also require other standard as occupational health and safety management system to prevent potential risks, hazards that may arise during operation within platform that create safety environment or atmosphere throughout the enterprise, which uplift reliability of the organisation that interacted with brand image of the organisation and it is mandatory to be maintained.

Furthermore, safety culture is an essential for safety management system but the relation between SMS and safety culture is both systems has different perspective and proper implementation, which both support each other in a positive way that resulting higher mobility to the organisation in term of operation safety. Moreover, safety performance is monitored by means of safety performance indicators but aviation safety performance should provide the indicator that suits to probability of an accident, development and measurement of proper safety performance indicator. Nevertheless, leading indicators are associated to managerial or upper level in the organisation, which takes time to quantify the relation of accident risk from the occurrence. In addition, reporting system is gather by reporting system manually or digitally via capable devices that majority of employees acquired but underreporting could create obstacle towards analysis and it is necessary to investigate differences in safety performance before any conclusion towards relative safety performance or occurrences (Roelen & Klompstra, 2012).



As it is requirement stated by ICAO Manual on the Quality Management System for Aeronautical Information Service, Section 1.3.1 justified as “In addition to specifying the quality requirements for aeronautical data, Annex 15 requires States to introduce a quality system to implement quality management at each of the function stages of originating (or collecting), collating or assembling, editing, formatting, storing, publishing and distributing of aeronautical information. Annex 15 also recommends that this requirement be met by establishing a quality system that complies with ISO 9001”, International Civil Aviation Organisation, as well as OHSAS 18001 where have to migrate to ISO 45001 OHSMS (Nqa, 2017). For instance, in chapter 5 has been illustrated quality and safety systems that being integrated in the organisation by the co-operation between each essential information, procedures and framework, which under the missing gaps that Part 145 does not being clarified, ISO 9001:2015 and AS9110c covering the missing gap in the organisation as well as Annex 19 Chicago convention. For example, missing element as PDCA cycle does not being clarified in Part 145 but it has been exposed to the system by ISO 9001:2015 aspect. In addition, risk based thinking philosophy has been emphasised in the operation and management, which does not being described in Part 145 but ICAO annex 19 Safety Management has introduced Integrated Safety Management concept that covering maintenance activities towards human capital, documents and other relevant process in the carrier. Furthermore, quality and safety are cultivate continuously, which by gathering information of structure, framework, module, relevant requirements of minimum standards applied to aeronautic maintenance organisation improves more vision that can be visualised towards quality and safety systems in the enterprise that integrated towards various sub-systems from supplier to maintainer. In addition, complexity of systems that operating in the carrier might contribute confusion towards its complexification, which by emphasising, interpretating and comprehending the relevant information must narrow down the diversified regulations, standards, certifications and permission of the carrier externally and internally. In addition, to recurrent the organisational approval, the carrier shall comply to Part CAMO or Part Continue Airworthiness Maintenance Organisation.

This dissertation topic is “How Safety Management System and Quality Management System applied and integrated in Aeronautic Maintenance Organisation?” As by the exploration of the dissertation question, it can be illustrated as quality management system and safety management system has been cultivated continuously. Therefore, it starts to integrate seamlessly in the same module under the assistance of technological platform as integration of relevant information without interfering between its structures, procedures and processes that can be seen in chapter 5. This dissertation is aimed to study or interpret framework, structure, module and requirement of quality and safety as well as cultivation and integration of quality management system and safety management system in aeronautic maintenance organisation under the International Civil Aviation Organisation enforcements.

## Chapter 2

### Background

#### 2.1 Quality safety in aeronautic maintenance organisation

This section is about the path and overview of quality and safety systems in aeronautic maintenance organisation. Quality is a complex term that is mandatory to production and service provider, which all businesses aim to maintain their product or service with high quality or having higher value or feature that customer expected and higher level of quality, which it is a primary way of increasing value in maintenance towards competitors in the market. Quality product or service means a set of relevant features in product or service consistency and reliability in order to be safe to use, which set by customer or user.

Quality feature is product or service reliability means that it operates correctly within possible occurrence of damage or unpredicted random event within specific time interval that affects operation safety. Furthermore, the system is defined as a set of elements that interoperate during the operation to maintain reliability structure. As an aircraft maintenance has to maintain its airworthiness or to acquire the qualifications that can persuade aircraft to be fit to fly. Therefore, it is required to comply to diversity systems in order to guaranteed the reliability, accuracy and quality of works. For instance, tasks related to maintaining aircraft airworthiness are periodic technical maintenance process as maintenance and inspection activities in accordance of technical maintenance instruction with specialised working station in the technical maintenance schedule. Last but not least, aircraft repaired within aircraft maintenance and repair sub-system described as a condition of remaining damaged technical object in the working station and subjected to restoring aircraft airworthiness after putting an aircraft into AOG or Aircraft On Ground condition.

Management is a process of planning and running the organisation directly and indirectly that influence organisation's product or service quality, which its efficiency is the quality values that reaching desired level as well as completion of executives processes within the alignment of results. Aircraft maintenance and repair process by maintenance and repair organisation required management system in regional and local regulation, which is known as Part 145. As the same numeration of regulation but the context of the regulation of each regional, domestical and international of each country in the world does not being equivalent by minimum standard towards higher standard. For instance, European regulations such as JAR or Joint Aviation Requirement or regulations applied to European open sky as European Aviation Safety Agency or EASA Part 145 and regulations that applied in the United States

of America as the Code of Federal Regulations title 14, Aeronautics and Space – 14 CFR Part 145 had significant differentiation, which describe scope of maintenance differently but both are requirements under the same mean of result that has been accepted towards the globe. Furthermore, from differentiation of the scope of maintenance with inability to verify maintenance procedures. Therefore, the component of both are slightly different as the standard in an introduction of technical maintenance program, area of personnel certification and qualification requirement from training programs, which in these differentiation, in 2008 both agency and authority has been agreed on bilateral agreement between European Union and United State of America on recognition of airworthiness certification that issue by certified organisation from the countries that monitored by EASA or European Aviation Safety Agency and FAA or Federal Aviation Administration. FAA prerequisite of recognition of airworthiness certificate that issued by authorised and monitored countries from FAA and EASA, which beside complying to EASA Part 145 but to comply to Foreign EASA Part 145 and FAA Part 43 (Part 145) for the countries outside the EU and the US in order to be qualified and issued airworthiness certification, which under the agreement of recognition and complying to continue airworthiness maintenance organisation to continue the license (Wozny & Blachino, 2004).

### **2.1.1 Overview of Quality in Aeronautic Maintenance Organisation**

(Wozny & Blachino, 2004), Quality assurance is a complex system or department, where monitorisation, planning, assessing and correcting circulate with various compliances, standard procedures, instructions and regulations that applied to organisation and its technical area with particular emphasis on development of quality management system and safety management system as the element of quality assurance system. A crucial prerequisite to establish product quality and acceptable inconsistencies are management and executive activities that are formalised by principles to ensure repeatability and stability of aircraft maintenance and repair processes. Therefore, formality of principle that executives include quality assurance, which is aim to minimise errors and develop optimum quality control system. Since aircraft maintenance and repair sub-system are based on norms and developed standard regardless on disadvantages, trails and error methods as well as costs that applied to aircraft maintenance organisation and repair sub-system, which in this all applied standards, practices and regulations helping carry out responsibilities and acceptable level of respect towards safety and customer satisfaction.

Furthermore, flow cycle with maintenance and repair sub-system cycle diagram has been a part of monitoring quality of product or aircraft in order to gain airworthy, which associated with aircraft designing, constructing and manufacturing, which required to monitor aircraft manufacturing, aircraft operation and maintenance process, which stages of flow cycle are form of

- Development of design system of structural conditions required safe operational instruction as well as repair and maintenance instructions, which aim to process the restoring of aircraft's airworthy, which lost of airworthy is considering as failure.
- Products or components that producing from manufacturing system under structural condition with manufacturing technology by manufacture shall be approved in the course of certification processes.
- Products or components that operate by user shall comply to the instructions and limitations specified by the design system.
- Restoration by maintenance organisation shall maintain product airworthiness with structural conditions of failure or operation.

The maintenance and repair sub-system diagram below shows the flows of how information and life cycle between technical object and sub-system, which helps sub-systems to carrying out individual task of the product within analysis of technical user feedback known as the Market Feedback Analysis or MFA to the design. Therefore, it is covering aircraft maintenance and repair sub-system to communicate and cooperate to necessary acknowledgement. MFA consist of systematic collection of products or service rendered, which showing below (Figure 2.1) as,

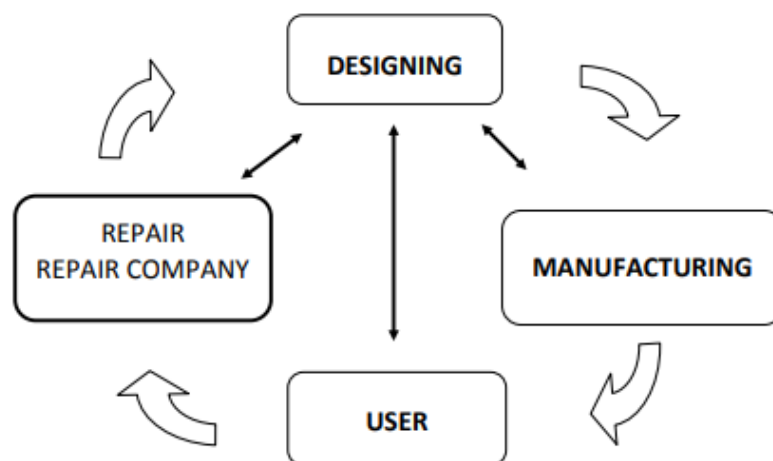


Figure 2.1 Repair company and repair sub-system flow chart

Nevertheless, monitoring of measurement processes has been made towards maintenance organisation and its sub-system to concern an effectiveness of failures and malfunctions diagnosis that may exist in any time. Therefore, measurement process is carried out in order to testified and monitor sub-system for the purpose of maintaining quality when task has been carried out. Measurement of sub-system is related to ISO 10012:2003 standard as well as Allied Quality Assurance Publication or AQAP standard, which impose obligation to monitor equipment used and measurement processes. In addition, it contains

guideline and framework of general management in order to ensure the metrological requirement of measurement of equipment testing in the aeronautic maintenance organisation. Which the measurement and laboratory testing that the organisation has to comply to the provision of ISO/IEC 17025:2017 or (9000 store) a standard that produced to assessing Certification Bodies (CBs) or registrars as to ensure that the organisation is competent to all types of management systems and the standard assisting registrar to be impartial or fair while audits are consistent that aligning with mentioned standard, which specified requirement to prove laboratory features as,

- ❑ Function and efficiency of quality management
- ❑ Requirement of technical competencies
- ❑ Ability to obtain reliable results
- ❑ Grounds for accreditation.

In addition, (Wozny & Blachino, 2004) the diagram below illustrating the process of measuring equipment metrological confirmation, which carried out by aircraft maintenance organisation and repair sub-system. In addition, metrological confirmation has been predicted as a protocol that illustrated below (Figure 2.2) as,

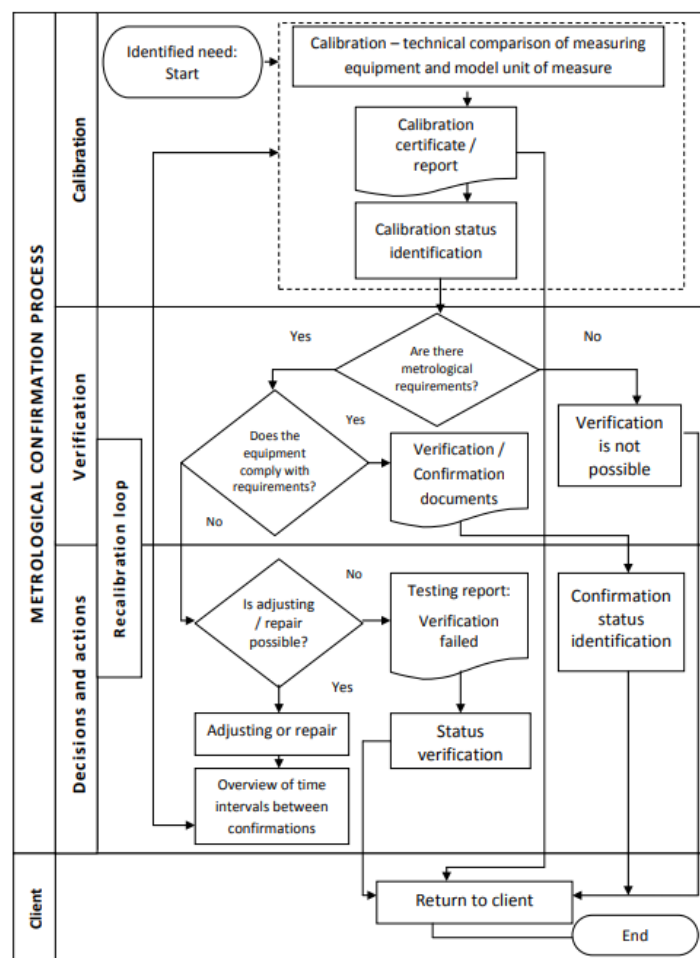


Figure 2.2 Metrological confirmation process chart

ISO 9000 standard are universal standard that applied throughout any format of industry and product, which such universal standard also applied in maintenance and repair sub-system. In addition, ISO 9000 series are composed with three standards throughout maintenance organisation and (Lutkevich, 2021), it forms of groups of individual standards as,

- ISO 9000:2015 is an illustration of the Quality Management System (QMS) fundamentals and vocabulary
- ISO 9001:2015 is an outline of Quality Management System
- ISO 9004:2018 is a guidance to achieved sustained success in Quality Management System.

ISO 9000 it is a standard that pursuing fundamental vocabulary, concepts and principles for ISO 9000 series, which covering basics of quality management and seven management guidelines. Moreover, ISO 9001 is a standard that required an organisation to meet the certified compliances within frameworks that leads the path of the organisation to sustain their products and services that meets customer anticipation as well as other regulatory requirements, which considering as a process of Quality Management System improvement. In addition, ISO 9001 leads the organisation to conduct internal audit in order to get certified, which ISO 9001 shows the ability of the organisation to contribute a sustain products and services with quality via requirements. In addition, internal audit is required to maintain the organisation under ISO 9000 path, which referring to ISO 9001 clause 9.2.2 provides the guidance on internal audit as processes. Therefore, to gather the ISO 9001 standard, the organisation shall demonstrate following criteria as,

- The organisation complying ISO 9000 guidelines and requirements
- The organisation follows its own guidelines and requirements
- The organisation shall meeting statutory requirements as laws, rules and regulations
- The documentation of the organisation shall reflect its performance and capacity.

ISO 9001:2015 providing minimum requirements towards QMS, which motivate delivery of product consistency towards customer satisfaction or requirements. As the result of it, to apply the following standard, the documented procedures are illustrated in maintenance and repair sub-system as,

- Monitoring of the documentation
- Monitoring of the provision related to quality
- Carrying out of internal audits
- Implementation of preventive and corrective measures
- Monitoring of inconsistency.

Standardisation is a form of rules, methods and practices, that uplifting and shaping product quality in the organisation, which aircraft maintenance and repair sub-system are subjected to ISO 9000 series that providing basic terminology, requirements and guidance towards quality management system. Therefore, guidance towards adoption and adaption of the system throughout maintenance and repair sub-system has been provided in the ISO 9004 standard, which provisioning effective and efficient in the organisation within integration of process and management and emphasising such approach as,

- Comprehending compliance with requirements
- Required process of added value
- Result obtainment for operation and process efficiency
- Continuously improve on objective measurement.

Referring to clause 10.3 in ISO 9001:2015 has provided Continual Improvement of QMS that is a pavement for continuously improvement inside out of the organisation towards product or service launch that collaborated with customer and other parties satisfactions, which illustrate below (Figure 2.3) as,

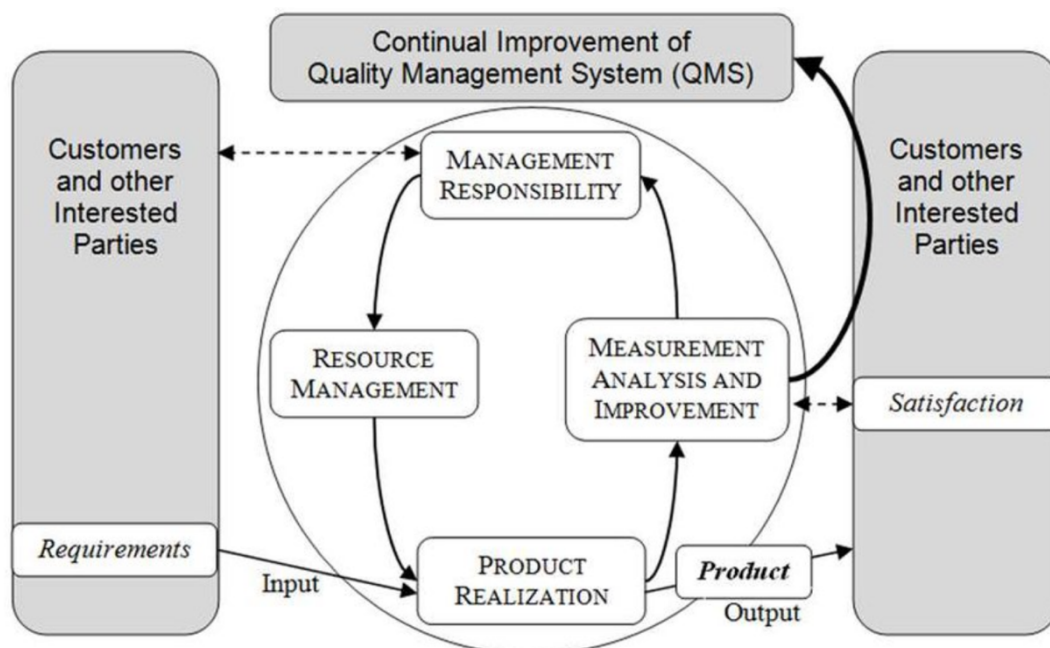


Figure 2.3 Continuous quality management system improvement

(Keen, 2021) Continual improvement has been operate objectives of top management that shall be included in order to pursue the improvement of internal efficiency, individual customer requirements and performance that the market anticipated. However, there is no requirement that the organisation shall set an improvement objective towards all processes simultaneously and each improvement must committed to the resources that prioritised by top management. Continual improvement seems like a philosophy rather than a process, since all sections shall participate to adopt it into a usual framework

to become their norms to continuously searching for improvement on the existence processes and systems efficiently and effectively. Nevertheless, resources that top management shall prioritise are,

- Customer satisfaction
- Customer complaints and feedback
- Market research and analysis
- Contribution from employees, repair sub-systems and other relevant parties
- Internal and external audits under quality system
- Records of non-conformances
- Data from process, product or service characteristic and market trends.

In addition, there are ISO 9001 requirements that must be determined in continual improvement as,

- QMS planning
- Quality objectives
- Risks and opportunity
- Recommendations for improvement
- Improvement of the system, processes and products
- Analysis and evaluation of data.

Continual improvement procedure is aimed to define organisation process for establishing continual improvement philosophy throughout the carrier that might be documented in the objectives and policies.

(Wozny & Blachino, 2004) ISO 9004:2018 presenting improvement of quality management system regarding on sub-system to maintain airworthiness of technical object, which performs roles and guidelines within area of process improvement. In order to improve effectiveness and efficiency between the organisation and sub-system, which the relevant auxiliary standard has been applied towards document procedure, which illustrated below (Figure 2.4) as,

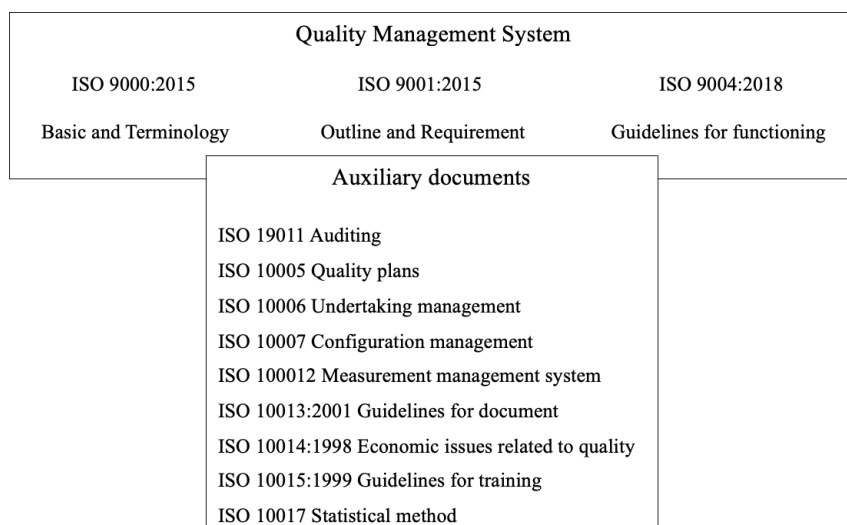


Figure 2.4 Structure of ISO 9000 series and auxiliary documents



Due to strict requirement regarding on product safety, aviation industry has paid attention and applied AS 9100 as a supplementation of ISO 9000 series, which developed by eleven aviation organisation as Boeing, GE, McDonnell Douglas, Pratt & Whitney, Lockheed Martin, Sikorsky and other more, in order establish rules, responsibility and standardised regulation and standard procedure. In addition, AS 9100 has been adopted towards globally with civil aviation and military aviation industry. Therefore, the requirement imposes aircraft maintenance and repair system in the area of,

- Configuration management
- Reliability
- Maintenance
- Safety
- Special processes
- Validation of processes, planning of stages
- Suppliers assessment
- Procurement verification
- Designing
- Product documentation
- Monitoring of product changes and process changes
- Monitoring of software used in automation processes
- Monitoring of work outside the organisation
- Internal audit
- Article inspection
- Overview and efficiency of inconsistency handling and management

The AS 9100 standard is further supplement by AS 9110 as known as Quality Management System – Aerospace Requirement for Maintenance Organisation, which applied and published in January 2003 and being a part of maintenance organisation since.

### **2.1.2 Overview of Supplement Quality Management System in Aviation Industry**

(ISO Update, 2017) AS9110 standard was established in January 2003 after the aviation industry realised the differentiation of OEM or Original Equipment Manufacturers. The standard is fully titled itself as AS9110 Quality Maintenance System – Aerospace – Requirements for Maintenance Organisation was developed by International Aerospace Quality Group or IAQG through SAE or Society of Automotive Engineers as the U.S. engineering professionals in various industries. The AS9100 involving specific endorsement that is critical for MRO in all sectors as commercial, private and military aircrafts. Aviation safety is crucial towards millions of people are flying globally and

expecting to reach their destination with safe manner, which air operator organisation required to cooperate with proper maintenance organisation to maintain worthiness of the aircraft to be able to operate with its worth. In the MRO or AMO industry, there are various of organisations that rely on inspection and audit of their quality controls rather than confront with failure towards task performing until the deadline of the case. Nevertheless, AS9110 emphasised in the area of,

- Detecting and preventing suspected or unapproved parts
- Recognising human factors that are related to tasks or job
- Complying to safety management system
- Recognising and maintaining technical data
- Cooperate with project management and risk management.

AS9110 standard is also a prime part of FAA Part 145 Certified Repair Station and Part Manufacturing Approval or PMA from the FAA to the manufactures of the aircraft parts and components are also relevant to the AS9110 certification, which all MRO are subjected to AS9110 towards comprehension of the system and focus area on product or service reliability. Furthermore, organisations that successfully establish and implement the AS9110 can benefit towards solid quality management system that boosts their performance by,

- Providing access to the greatest practices of the aerospace or aeronautic industries
- Identifying and maintaining authorities requirements
- Confronting, meeting or exceeding customer requirements through a system of continual improvement
- Ensures that airworthiness, integrity and safety of the products are brought back into the service.

Those organisations that decided to be certified with AS9110 will be listed in the Online Aerospace Supplier Information System or OASIS, which the internet database may publishes all aerospace quality certifications that are required by diversify OEMs and will undoubtedly expand the market of the organisation and lift their QMS to the global standard, which adopted by the aerospace industry.

### **2.1.3 Overview of Safety in Aeronautic Maintenance Organisation**

Aviation operators or service providers are subjected to comply with legislation and regulation concerning safety management system within other management systems such as, quality management, security, occupational safety and environment protection. This requires correct balance to implement different management system in the organisation as well as comprehend and recognise possible conflict that may arise from diversified regulations. In addition, such conflict must solve internally, which if

necessary, the conflict shall agree by regulators. As the result of it, regulations allow integration of various management systems into one complex management system. On the other hand, it is mandatory to implement suitable system to suitable situation that solves, improve and maintain the standard or goals of the applied system continuously, which required structural implementation towards all levels that in charge. For instance, safety risk management or SRM is a fundamental of SMS or safety management system and is not a part of QMS or quality management system but product realisation is a fundamental of QMS. In addition, SMS is concerned with safety towards operation and OHSMS is concerning on health safety of employees in the operation. Safety culture is essential to safety management system, even though it does not required in the implementation of SMS and by exception of Performance Scheme Regulation for air navigation service provider or ANSP that require on the measurement on safety culture. The relation between SMS and safety culture is both systems has different perspective and proper implementation, which both support each other in a positive way that resulting higher mobility to the organisation in term of operation safety.

Performance of SMS are monitored by means of safety performance indicators and it should provide the indicator that suits to probability of an accident, development and measurement of proper safety performance indicator, since it does not clear under the enforcement or regulator. Leading indicators are associated to managerial or upper level in the organisation, which takes time to quantify the relation of accident risk from the occurrence. The performance scheme regulation enforced safety performance indicators, which they might arise certain difficulties. As there are composite indicators, value of that applied in the organisation can be weighting it systems, since integration to risk control process remained unclear. Reporting system can be gathered by manual or digitalise reporting system, which underreporting could create obstacle towards analysis and it is necessary to investigate differences in safety performance before any conclusion towards any occurrence that may arise (Roelen & Klompstra, 2012).

## **2.2 Cultivation of quality and safety management systems**

This section is about an update of ISO standard that is developed from previous framework, structure and procedures, which considering as an uplift of the standard and the organisation themselves.

### **2.2.1 Mobility of ISO 9001:2015**

Since, quality has been integral part of logistic for several years in order to maintain quality of the output and management in the organisation, which up lifting it into word class standard in the logistic industry towards all dimensions as to transfer mail, cargo and people started to adopt ISO certificate

with the first certification of ISO 9002 in August 1998 and recertified it in August 2001 as ISO 9001. ISO certificate issued by the International Standard Organisation as a worldwide federation founded in 1946, which aim to promote a development of the international manufacturing, trade and communication standards that composed 147 member countries as well as American National Standards Institute or ANSI for the United States of America. ISO standard certification is guarantee that the organisation shall operate with quality management system based on seven quality management principles to provide improvement of the management in the organisation, utilising Control/ Organisation/ Planning, motivate great consistency across organisation sites, improved customer service and satisfaction, improved staff motivation and reduce waste. Therefore, ISO 9001:2015 has involved seven principles of quality management system as,

- Customer focus
- Leadership
- Engagement of people
- Process approach
- Improvement
- Evidence-based decision making
- Relationship management

Nevertheless, the organisation shall utilise Plan, Do, Check and Act methodology to provide a process-oriented approach to documenting and reviewing the structure, responsibilities and procedures, which required to achieve effective quality management in the organisation (Federal Aviation Administration).

Quality management system is required to be in an air maintenance organisation, which benefits all dimensions and values as a team work under restricted procedures, licenses, authorisations, safe, sustained and reliable towards product and service launched, which are the out-put of the organisation's quality that are controlled by QMS under ISO or International Standard Organisation and AS standard or quality management system that co-ordinated with ISO 9001:2015, which specifically used in aircraft industry. As the result of this, the QMS are form of,

- Quality assurance or process dealer
- Quality control or physical product dealer
- Complain monitoring function, which is another quality assurance function that is dealing with regulation requirement, policy and procedure
- Quality management

Which, ISO 9001:2015 applied to aviation organisation that is emphasise QMS framework as monitoring complains and personnel competence management or corrective actions, effectiveness and communication towards result inside out. For instance, the management review and the stakeholder

satisfactions does not addressed in aviation safety regulation, since QMS in aviation required more than what is applied in other industry within assurance and safety regulations. The QMS is aimed to provide consistency of the product or service delivery under customer satisfaction and authority regulations towards the systems such as QMS and SMS, which required governance structure and independent assurance as an objective as,

- Quality assurance utilised and manage ineffective process and procedure to redesign the structure under effectiveness and efficiency
- Safety management system utilised and manage safety related hazard, risks and safety performance in the organisation and control it to an acceptable level

In addition, to define the quality beyond other industry beside quality control, it involved quality assurance and quality management. Therefore, ISO 9001 does complied risk management in term of risk assessment and opportunity towards preventive action from an upper level regarding of process, methodology, operating environment, value and culture of the organisation to ensure effective safety management (SM ICG, 2018). Nevertheless, ISO 9001:2015 shall also integrated to AS9110 in order to create rightful Quality Management System especially for maintenance organisation as an example as, Quality Management System for Aircraft industry or AS9110 is an Quality Management System for aeronautic maintenance organisation that is providing Maintenance, Repair and Overhaul in an aircraft industry.

### **2.2.2 Mobility of ISO 45001**

In March 2018, OHSAS 18001 was officially supersede or taking place by ISO 45001:2018, after the standard such as, ISO 9001:2015 and ISO 14001:2015 or Environment management system. In addition, structure of ISO 45001 is based by the same Annex SL format that supports the integration and implementation of the mentioned standard that required the organisation to determine their context. Moreover, mentioned standard in section 4 of ISO 45001 justified that the standard is a complaint of ISO standard.

In the past decade, e-commerce is impacting the organisation to adapt the trend of the industries. From then, the organisation has to adopt their processes, procedures and documentations to become digitalised. However, by adopting and adapting digitalisation format in the organisation after the systems may contribute confusion towards comprehension of the platform that operated in the organisation but taking time for familiarisation of the system, which the context of the organisation functions is required to take a stand of responsiveness in the relation of the management system positively and negatively. Nevertheless, to anticipating the context of the organisation, it should answering questions below as,

- Why do we do this? And Why this is crucial to the organisation?
- What is the outcome or benefit to be received by the accomplishment of the system?
- Where and who is the requirement is from? Are there any issues with legal or compliance?
- How do the organisation meets the requirements? What is the most fitting action to take?
- How do the organisation meets delivery requirements? What is the most fitting action to take?
- How do the organisation realise in succeeding the intended outcome? How to verify the intended outcome or result?
- What to do if the intended outcome cannot be delivered?

The above questions are helping to identify internal and external issues that has been exposed by the enterprise, which analysing the factors are supporting realisation of the carrier, market, competitors, environment, trend, social delicacy and relevant legal requirements that support decision making of the organisation towards the movements that has been made. Scope of OHSMS can be determined after the context has been firmed within documentation information with a factual statement that representing operation under the management system. On the other hand, the benefits of defining context of the carrier can be described in various points, which supports the organisation to be firmed and systemised in the area that the standards are covered. Moreover, it helps the enterprise to comply with all rules and regulations of the industry that prevent the business from legal and financial liabilities. In addition, it enhancing safety and well-being of the employees, especially when technology incrementally developed in working environment and well-being of people such as, digitalisation of procedures and usage of robotics for special tasks, which create risks towards health issues that may existed in the employees mentally and physically. Therefore, under the role of OHSMS is to prevent injuries and illnesses by appropriate equipment, procedures, and processes that being recorded by documentation information (Nqa, 2017).

### **2.3 Relationship, similarities and differentiation of quality and safety management System in aeronautic maintenance organisation**

This section is about relationship, similarities and differentiation between QMS and SMS that applying in the aeronautic maintenance organisation, which filling the gaps of failure towards loop hole between those systems as well as comprehended the differentiations of both systems to prevent confusion towards operation under the systems.

### 2.3.1 Relationship between quality management system and safety management system

As the adoption of Quality management system framework consisted of documentation in four areas such as,

- Management responsibility
- Resource management
- Product realisation and measurement
- Analysis and improvement

This standard is considered as a sufficient means of compliance for an ANSP or air navigation service provider, which means that all sectors that providing service such as, aerodrome, technical hangar, flight operator and air traffic controller to comply QMS in the operation and management. However, under EU-OPS or requirement for quality system under European sky or any ANSP to fly over or land and take off, which does not referring to implementation of QMS, as well as ICAO except Part 145 or approved maintenance organisation. In addition, quality management that purposed by EASA does not justify clear relationship between SMS and QMS beside justifying differences in roles and approach of the system to the organisation. Therefore, by observing the definition of both systems it results as QMS is applicable to any organisation, which focusing on process of product or service tangibly and intangibly by realisation of the organisation, under the focus of customer satisfaction but does not required hazard identification, which SMS focusing on hazard identification from reactive, proactive and predictive from safety performance that is monitoring by safety performance indicator (Roelen & Klompstra, 2012).

Nevertheless, (SM ICG, 2018) quality assurance and quality control has have given efficiency and effectiveness to the SMS by maintaining and improving its process or operation and being able to identify system deficiencies and non-complain regarding on internal and external regulatory requirements by hazard identification, safety risk management and safety assurance process to improve overall organisation efficiency. In addition, PDCA approach or Plan, Do, Check and Act is an approach or strategy that is a component of the quality management, which integrated in safety management and blended as a single management system, which justified as,

- QMS supporting and informing SMS in the process of auditing, inspection, investigation, root-cause analysis, process design, statistical trending analysis, preventing measure, documentation and training.
- Anticipation possible safety issue that existing in the compliance of the organisation with standard and specification under the operation with SMS.
- QMS solidate the foundation or information and supplying SMS in order to performed covering customer satisfaction, applicable statutory and regulatory requirements.

- Justification of the system should fulfilling the consideration of risk under particular planning and performance of internal audits.

In addition, QMS and SMS are relying on management systems to plan, do, check and act on its operation to succeed organisational goals and requirements (internally and externally), which promotes all principles of the ISO QMS. Nevertheless, ISO 9000 series framework also encouraging an effectiveness of SMS to,

- Understanding internal and external contexts
- Planning
- Process analysis
- Internal auditing and root cause analysis
- Clear assignment on organisation structure, responsibility, authority, communication and training
- Foresting organisation knowledge
- Persuade management to keep review continuing stability, adequacy, effectiveness and alignment of organisation strategic direction.

### **2.3.2 Similarities between quality management system and safety management system**

(SM ICG, 2018) Quality and safety having the same goal on providing safe, reliable and sustain product and service to customer. Moreover, data that generated by QMS helps identifying possible safety risk and safety data helps quality auditors targeting safety in critical processes. In addition, similarities of SMS and QMS under ISO 9000 series can be illustrated as,

- Plan and continuously managed
- Senior management commitment
- Standardised organisation documentation, process and policy
- Use of data information in evidence based decisions
- Comply to measurable objective
- Performance monitoring
- Record of process output
- Involve all functions relating to product or service delivery
- Effective management change
- Should be auditable
- Comply to improvement continuously.



Therefore, cooperation between each system leads to greater and smoother performance as to be integrated nor managing both separately.

### **2.3.3 Differentiation between quality management system and safety management system**

QMS is traditionally fulfilling customer and stakeholder expectation regarding on customer, regulatory and statutory requirement, which SMS is relying on safety and safety risks when operations or processes are performed in the exact fulfilment of QMS within delivering safe transportation. Once QMS within SMS are developed under Annex 19, it can be justified differences of each in term of terminology, objectives and certain focus area such as,

- QMS is focusing more on customer satisfaction with applicable requirements to minimise risks and maximised opportunity.
- Auditor under QMS is focusing on processes and procedures of product and service from diversified specifications, which SMS required an analysis of unwanted event and hazard within investigation and safety risk analysis over irregularity and all influences or contributing factors and sources or likelihood.
- QMS is requiring management to have an overview of the business within performance metrics, while SMS requiring management to focus in safety risk as its effectiveness to control and monitor.
- QMS is reacting and focusing on existing processes while, SMS in charge on existed events.

SMS is taking a pragmatic approach on possible procedures and practices together with quality management system. It assures the design, organisation processes and procedures to identify safety hazard, control and mitigate safety risk in aviation operation. On the other hand, QMS provide a structure approach towards processes and procedures, correction of non-conformance when necessary and continuously improve their effectiveness. In addition, it ensures effectiveness and efficiency of the company structure, repeatable fashion and being able to meets organisation objective, if not, provide means of improvement. While, SMS carry out a framework of operational function under risk-based decision making and taking dominant role in an organisation within integrated management system as unified goal and risk based decision that are making towards all movements in the organisation, which supports achievement of overall organisation goals (SM ICG, 2018).

## **Chapter 3**

### **Approvals , Certifications and Quality Management Systems of Aeronautic Maintenance Organisation**

#### **3.1 Approvals and Certifications in Aeronautic Maintenance Organisation**

This section is mentioning quality management systems in air maintenance organisation, which are the minimum qualities that shall be acquired. For instance, Part-145, Part-147, Part-66, EU-OPS, ISO 9001:2015 and AS 9110 , which defined clear justifications on responsibility, authority, regulations, restrictions and other relevant practices that aims to operate the organisation effectively and efficiently as well as ensuring if the structure and repeatable fashion meets the organisation objective within means of improvement when confront with change, or required to adapt and adopt by providing processes and procedures within corrections when the effectiveness does not being improved continuously. In addition, to obtain a permission to operate, it required approvals along with the standards that monitor inside out to guarantee if the organisation is on the standards.

##### **3.1.1 Part 145**

Quality is a complex part that is being adopted towards majority industries by global recognition that become mandatory especially in aviation in order to maintain product or service as well as the organisation itself with high quality or value that being satisfied by customer and consumer. In addition, continuously improvement is a crucial key of maintenance since high reputation or competitors existed in the market. Therefore, to maintain consistency and reliability of organisation's product or service, the organisation required management that is (Wozny & Blachino, 2004) a process of planning that runs the organisation directly and indirectly that influence product or service quality, which considered its efficiency as its quality values in the desired level as well as completion of executives processes within the alignment of results. Aircraft maintenance and repair process by maintenance and repair organisation required management systems in regional and local regulations, which is known as Part 145. By the same numeration of regulation may not or might not justified the exact enforcement towards each region or territory in the world but it came from the same root that obtained the same mean of results. For instance, European regulations such as JAR or Joint Aviation Requirement or regulations applied to European open sky as European Aviation Safety Agency or EASA Part 145 and regulations that applied in the United States of America as Code of Federal Regulations title 14, Aeronautics and

Space – 14 CRF Part 145 had significant differentiation, which describe scope of maintenance differently but both are the standard that has been accepted towards the globe. Furthermore, from differentiation of the scope of maintenance with inability to verify maintenance procedures. However, component of both are slightly different as the standard with introduction of technical maintenance program, area of personnel certification and qualification requirement from training programs, which in these differentiation, in 2008 both agency and authority has been agreed on bilateral agreement between European Union and United State of America on recognition of airworthiness certification that issue by certified organisation from the countries that monitored by EASA or European Aviation Safety Agency and FAA or Federal Aviation Administration. FAA prerequisite of recognition of airworthiness certificate that issued by authorised and monitored countries from FAA and EASA, which beside complying to EASA Part 145 but to comply to Foreign EASA Part 145 and FAA Part 43 (Part 145) for the countries outside the EU and the US in order to be qualified and issued airworthiness certification, which under the agreement of recognition.

### **3.1.1.1 Scope**

(Sofema Aviation Services, 2018) Regarding on AMO or Aircraft Maintenance Organisation that is responsible to perform and approving tasks in accordance with documentations, materials, release aircraft back to service when the necessary task has been done towards appropriate approach, which in the coverage of EASA Part 145.A.50 as certificate of release back to service or CRS when the maintenance tasks has been done and as a part of EASA 145, it is mandatory for AMO or the organisation to comply with the required work scope as,

- Component Service bulletins
  - SB or service bulletin is not mandatory but it is an opportunity to practice the task towards the organisation. On the other hand, the owner of the aircraft must be acknowledged and allow the SB to be performed, since requirement often combined with the risk assessment and return expenditure analysis. In addition, service bulletins are only enforce by certain country and certain aircraft type or series to stayed airworthy under appropriate approach.
  
- Findings during initial assessment
  - It is possible that findings are beyond economical repair as known as BER, which in majority of cases, it is mandatory to illustrate communication protocol to the owner of the aircraft in order to make an efficient decision and documentation throughout effective communication.

- CRS or certificate release back to service only issue when the component, part, system has been assessed, tested and inspected, which defect will prevent CRS from being issued with comprehension between AMO or aircraft maintenance organisation to customer via efficient communication.
- Customer acceptance are forms of signature acceptance and engineering controlled order or document referring to the task.

### **3.1.1.2 Requirements**

(UK Civil Authority International) In order to get approved by Part 145, there are topics that are required to be obtained and comprehended by air maintenance organisation such commercial MRO or Maintenance, Repair and Over haul holder as well as air operator in the case of an existence of technical department in the carrier in the topics as,

- Scope of Part 145
- Personal Requirements
- Certifying staff and Training requirement
- Interface between Part 145, Part 66, Part 147 and EU-OPS
- Aircraft Part acceptability
- Form 4 holders and management responsibilities
- Performance of maintenance programs
- Certification of maintenance
- The Maintenance Organisation Exposition or MOE
- Part 145 User guides and Work instruction
- Safety and quality policy
- Changes to an organisation
- Findings
- Part 145 requirements from authority

Which in this acknowledgement of Part 145 will prove air maintenance organisation to know how to operate the organisation under regulations and system used as well as Acceptable Means of Compliance or AMC and Guidance Materials or GM for decision making and standardisation of material use in the operation.

### 3.1.1.3 Activities outside of approved facilities

(Sofema Aviation Services, 2018) Activities and tasks of the organisation under the approval of Part 145 shall be observed by below criteria, which are,

- Clear work order from the customer or request
- Up to date technical data is being used
- Tasks and jobs are performed by authorised personnel
- Required tools, equipment and material must be ready on the site
  - Any special tools and parts must be transported to the working site, which tooling must be inspected in order to suits serviceability and suitability of the application or tools towards the task and not go against spare inventory.
- The required facilities and environment conditions are met
- Quality assurance or QA manager approved work right away for specific case and confirm in writing after analysed the details of the case.

CAA or civil aviation authority will be informed maintenance activities exclude or outside the maintenance hangar or location within 7 days by quality department by notification to CAA for work outside the approved location in the form or documentation. Work requirement will be negotiated and agreed upon contracted operator, which work requirement, negotiation and agreement towards contracted operator and customer may only carried out by MOE or Maintenance Organisation Exposition scope of work as known as compliance checklist and user guide to assist aircraft and its components. For instance, the scope of work shall be determined under the following information as,

- Aircraft type, series number and registration
- Aircraft location
- Reason of AOG or Aircraft On Ground nature of work to be carried out
- Supply of parts, upon the requirement of MOE or Maintenance Organisation Exposition.

Air operator or customer shall acquire a work package from the maintenance organisation, which information in the package must include, work order, task cards and current issues of relevant approved maintenance data or authority to access to the website within CD or clearance delivery as well as other relevant means to be followed. On the other hand, the certified engineer is responsible to correct performance of total task and completion of documentation as well as ensure that required equipment is prepared for serviceability and content against the return of defect. In addition, the certified engineer will retain all documentations and bring them to the base or station. Nevertheless, approved data from FAA or EASA under Part 145 to the AMO to be utilised contain information as,

- TC or Type Certificate data and specification sheets
- STC or Supplemental type certificate

- AD or Airworthiness Directives
- Manufacture approved data under DOA or Design Organisation Approval such as, AMM or Aircraft Maintenance Manual, SRM or Structural Repair Manual, CMM or Component Maintenance Manual and more.

### 3.1.2 Part 66

(Sofema Aviation Services, 2016) Part 66 (EASA) is a regulation of maintenance engineer to promote certified engineer to become an inspector or to be able to inspect, certify and release aircraft back to service after maintenance operation. AML has various categories, levels and routes. For example, category A is the license certifying ramp or line maintenance mechanically relevant to minor maintenance tasks as part replacement. In addition, category A AMEL or Aircraft Maintenance Engineer License must be supported under Part 145 as well as line maintenance or simple defect rectification under limitation of the organisation itself and restriction of the license holder under the organisation restriction on scope of work. Furthermore, process of AMEL with category is obtaining after 6 months of approved course within 1 year of appropriate certified experience. In addition, there is an alternative as self-improver or self-study of the module before requiring 2 years appropriate experience. Nevertheless, required experiences for line maintenance or B1 license are form of,

- 3 years of practical maintenance experience on operating aircraft if the applicant has no previous relevant technical training.
- 2 years of practical maintenance experience on operating aircraft and completion of training course within authorisation in skills that the applicant has been authorised and specialised.
- 1 year of practical maintenance experience on operating aircraft and completed with Part 147 basic training operation course.

Part 66.A.45 or type training or type rating training requirements are justified as,

- Holder of category A shall be only exercise towards specific type rating under the approval of Part 145 or Part 147 organisation.
- Training shall be both practical and theoretical under authorised task and type rating, which determined by examination and holder must be authorised with Part 147 and Part 145.

### **3.1.3 Part 147**

As Part 145 illustrate and standardised air maintenance organisation to know how to operate in the acceptable path. However, Part 147 or Maintenance training approval for related personals that relevant to task to operation tasks the task under the organisation approval and Part 66 for personal or inspector to certified the operation and release the aircraft back to service, which are the parts that mandatory under Part 145 in order to fully gain worthiness to aircraft, personals and the organisation themselves. Furthermore, Part 147 or Maintenance Training Organisation Approval is the standard to approve maintenance training program in the organisation, which consisted of two parts such as, basic training and aircraft type rating training. Basic training covering requirement to issue Part 66 or Aircraft Maintenance License or AML without aircraft type and aircraft type rating will deal with requirement and endorsement of particular type rating into Part 66 AML, which authorised by administers such as, Quality Managers, Training Managers, Examiners, Assessors, Instructors and Officers that helps organisation to demonstrate and maintain compliance to the inspector. In addition, AMC or Acceptable Mean of Compliance and Guidance Material or GM that associated to Part 147 and Part 66 will be taught in the class following with training material and Production of a Maintenance Training Organisation Exposition or MTOE align with other requirements out of Part 147 training (UK Civil Authority International).

### **3.1.4 EU-OPS**

EU-OPS 1.035 is a quality system with one quality manager to monitor compliance by the set of policies, processes and procedures, which required planning, and execution towards efficiency and effectiveness of air operations. The system integrate the internal processes that enable organisation to identify, measure, control and improve effectiveness within safety of the activities. Furthermore, EU-OPS 1.035 required following criteria as,

- An operator shall established one quality system with one quality manager or division to monitor the compliance with adequate procedures to ensure safety towards operation practices and airworthy of an aeroplane as well as compliance monitoring that include feedback of the system to accountable manager in corrective actions if necessary.
- Quality system shall include quality assurance that contains procedures and processes to verify all operations requirement, standard and procedures.
- The quality system and the quality manager must be applicable to the authority

- The authority might accept nomination of 2 quality managers, which one for operation and the other one is for maintenance that designated for one quality management unit to ensure that the quality system has been applied uniformly throughout the organisation.
- The quality system must be described in relevant documentation appropriately.

The EU-OPS material requirements has been amended to a law under EU-OPS 1.035 for Commercial Air Transport operator or CAT. Furthermore, section 3 appendix 1 of EU-OPS 1.1045 required an operator to contain a description of quality in the organisation such as, quality policy, description of organisation quality system and allocation of duties and responsibilities. Moreover, there are difficulties towards adaption and adoption to various management systems in the organisation due to the requirement of maintaining the systems within improving themselves continuously in the same time but it has been integrated successfully in diversify organisations worldwide. On the other hand, the most crucial for adaption and adoption of the organisation is to access to the suitable and appropriated sources, which the numbers of models and researches were identified it from discreet through fully integrated. Therefore it takes time for the organisation to adapt and apply the standards that the international, regional and domestical authorities are enforced to comply or migrate. Nevertheless, plenty of organisation nowadays begin to integrate safety management system and quality management together as setting up 1 safety and quality unit or department as directorate, which helps involved operators or workers to access all relevant information when the operator pursue maintenance and others activities to the aircraft (Skybrary).

### **3.2 ISO 9001:2015 and AS 9110 Quality Management System in Aeronautic Maintenance Organisation**

This section is mentioning requirements, scope, structure, documentation processes, nonconformity product disposition, KPIs, Internal audit, design process flow, Knowledge based, Organisation context, Aerospace supplement certificate, and illustration of quality management system modules of ISO 9001:2015, AS 9110c and Part 145 module of an example country.

#### **3.2.1 ISO 9001:2015 Structure**

(ISO) ISO 9001:2015 is the current version of ISO 9001 standard with requirements and other part in ISO 9000 series are illustrated guidelines and other relevant information. It is common for an organisation to publish and promote their ISO 9000 certification, which it means that carrier met the



demands of ISO 9001 standard. (Hammar) ISO 9001 structure is form out of 10 clauses, which one of a clause can be excepted as clause 8 in particular of clause 8.3, if the company or organisation found out that the clause does not applicable to themselves. Therefore, the structure of the standard is form of,

- Clause 0 – 3 are introduction, scope, references, terms and definitions about benefit of the organisation when the system has been implemented to the organisation from the principles, process approach, PDCA perceptual and risk-based decision making. Furthermore, it is common towards people to overlook this clause since this clause does not required any objectives to be complied beside the scope of the standard, terms and definitions.
- Clause 4 is context of the organisation, which an organisation is not a closed system where information is fully independent from the outside. In this section is mentioning about context of the organisation regarding of an internal and external issues that influence an organisation on setting a meeting towards the objective of the organisation, as well as an interaction between other parties or suppliers, requirement in scope, mapping and characterisation of the QMS.
- Clause 5 is combined between leadership, commitment and requirement of top management to promoting a customer focus across the organisation and developing and standing by a Quality Policy that sets direction, alignment, responsibilities, authorities and expectation of functions out of QMS.
- Clause 6 is planning for quality management system requirements for determining risks and opportunities until setting up workable quality objective that is aligned with quality policy.
- Clause 7 is support and resources management, which is complex due to requirement to provide resources, infrastructure, utilities, administrations, working environment such air conditioning in working space, control equipment used to monitor or measure product or service and the requirement of operating QMS as the importance of the competence, awareness and communication for human resources to be emphasised.
- Clause 8 is operational planning and control, which is the only part where the organisation can chose to opt-in or opt-out the requirement in the section as the design requirement of product or service, which including reviewing specification, design, development and purchasing between manufacture and supply. In addition, final requirement deal with quality control and nonconformities of product or service.

- Clause 9 is performance evaluation that has been outline the requirements for assessing customer satisfaction, internal audit, analysis and evaluation of process performance as well as management review between mandatory input and output.
- Clause 10 is improvement actions as the last section is establishing deals with improvement of the QMS through corrective actions and continual improvement.

### 3.2.2 ISO 9001:2015 Documentation requirements and Guidelines

(Meskovska, 2023) QMS under ISO 9001 has provided a guideline of quality management system documentation structure, which typically may assume by people of excessive documentations procedures and platform to adopt, since certain organisation may overboard on adopting in part that it does not suit to the organisation. On the other hand, it is mandatory to certain documents where the organisation required to adopt, which benefit themselves from a clear framework of operation in order to maintain consistency of the processes and becoming an evidence to the organisation when the objectives or goals has been reached. Nevertheless, foundation of the system documentation structure or QMS documentation hierarchy has been applied to levelling types of documents as Quality Policy, Quality Manual, procedures, work instructions, quality plan and records, which level of documents to be emphasised has been shown (Figure 3.1) below as,



Figure 3.1 Quality management system documentation hierarchy

Even though, ISO 9001 has been justified various type of documents to be allocated and utilised, which not all are include in order to determine the size and complexity of the documentation as well as level of detail that has been documented. For instance, a small entrepreneur is allow to adopt documented procedure in their QMS Manual if it fits the needs of the company and providing flows towards the customers. Nevertheless, (ISO, 2021) ISO 10013:2001 has been published the guidelines for quality management system documentation structure that indicates an effectiveness of the operation by the structure below as,

- Quality Policy shall represent a declarative statement of the organisation that involved commitment to quality and continual improvement within promoting quality objectives and goals that need to be emphasised, which needs to be published and acknowledged across the organisation in a clear and short form as to be convenient in general practice.
  
- Quality Manual should be fit the organisation that contains structure and content of the manual as complexity of the operation and competence of the personnel, which depending on size of the carrier. For example, a small organisation can obtain 1 manual about entire QMS, while large organisation contain diversified quality manuals, which include scope of QMS, exclusion from the standard, references to relevant documents and business process model including the Quality Policy. Nevertheless, the manual suppose contain following elements as,
  - Title
  - Table and contents
  - Scope of the QMS
  - Exclusion from ISO 9001
  - Versioning information
  - Approval
  - Quality Policy and objectives
  - QMS description
  - Business process model
  - Definition of responsibilities for all personnel
  - References to relevant documents and relevant appendices.
  
- Quality procedure can have various format and structures, which it can be described via text, using more tables and graphs. However, under the document guideline has been mentioning about quality procedures elements that demonstrated below as,
  - Title for identification of the procedure
  - Purpose that describing rationale behind the procedure
  - Scope to explain relevant and irrelevant contexts
  - Responsibilities and authorities of people and functions included any part of the procedure
  - Definitions and lists of all records that result from activities from the procedure
  - Document control by identify changes, date of review, approval and version of the document that shall be included according to document control practice.

- Description of activities is a main section of the procedure, which related to all other elements of procedures, activities and practices that supposed to be done in the organisation by whom, how, when and where from input to output within resources used.
- Work instruction can be a part or reference of process and procedure as a work instruction towards all procedures within details of activities that need to be concentrated together with planning in sequence of steps, tools, methods and other relevant resources accurately.
- Records and forms is demonstrating processes to reach to the requirements within evidence as record or form of owner decision to illustrate the process and activities that needs to be conducted to prescribed procedures and required work instruction. In addition, forms are a blank template to be filled with relevant information that is in an appropriate amount, which is not too less or not too much to become a data or record.

(Hammar, 2015) ISO 9001:2015 has been required document information to incorporate the documents and records, which defied as meaningful data that is required to be controlled and maintained by the organisation as processes, documentations and records. The requirement for documented information referred from section 7.5 of the draft standard includes existing requirement for documentations and records. The QMS needs to include documented information that required by ISO 9001 standard as a mean of effectiveness of the QMS, which needs to include capacity of the organisation and type of activity, complexity of the process, interactions and competence of people. Furthermore, there are requirements for creating and updating documented information including, identification, appropriate format and review & approval of documented information. The final requirement about documented information is control of availability and auditability where it is needed adequate protection, application distribution, access, retrieval, use, storage, preservation, control of change, retention and disposition. All of these requirements might existed in certain industry or organisation but the certification has been standardised documented procedures and records to a solid path as one set of requirement.

For instance, these are list of documentations required by ISO 9001:2015 are form of,

- Scope of QMS
- Supportation of operation processes
- Supportation of confident processes that resulted as aimed result
- Quality policy
- Quality objectives
- Evidence that monitoring and measurement of resources are fit for purpose
- Calibration standards when international recognised standard does not existed
- Evidence of competence

- Evidence that processes has been reached to the plan
- Evidence to demonstrate conformity of products and services requirements
- Results of products or services requirements review
- Conformation and approval of design and development requirements
- Output of design and development of changes
- Result of evaluation, monitoring of performance and re-evaluation of external providers
- Definition of characteristics of products or services, activities to be performed and achieved
- Information necessary to maintain traceability when it is required
- The results of changes to the product and service provisions
- Release of product or service to the customer including the person who authorising the release
- Concessions must be obtained on nonconforming process, outputs, products and services when actions has been taken
- Result of monitoring and measurement activities
- Evidence of implementing audit program and audit result
- Evidence of management review results
- Evidence of corrective actions towards nonconformities.

Regarding to annex of the standard has been described that it is not mandatory for organisation to change their terms that using with the new terms of standard. For instance, replace record or documentation with documented information, which there is no need to contribute confusion towards changing terms to call the same feature. In addition, if there are benefits in replacing two procedures for control documentation and records into one procedure with simplified requirements and the idea of QMS is designed for the organisation to control their processes and find way to improve.

### **3.2.3 ISO 9001:2015 Principles and Perspective**

(ISO) The fifth edition cancels and replaces fourth edition as known as ISO 9001:2008 to become ISO 9001:2015 with the appropriate perspectives, models and structures, which has been technically revised through the adoption of revised quality principles and of new concepts. Furthermore, the quality management system required PDCA or Plan Do Check and Act approach to be used under risk-based decision making. PDCA allows the organisation to ensure processes and resources management within opportunity of improvement. Which risk-based decision making create an ability to determine factors that may cause quality management system and its process to be deviated or fail the path by predicting preventive plan and controls to minimise negative effects and maximise any opportunity that may arise. Therefore, (Hammar) seven quality management principles under ISO 9001 has been made, which each one represent a critical focus towards elements in the system and the principles are form of,

- Customer focus or customer satisfaction is a foundation of customer focus in order to produce or launch product or service that is fulfil needs of the customer.
- Leadership is crucial to manage QMS successfully top management must provide and allocate resources appropriately with ongoing review of the system as well as, motivation and leadership that are not bias towards management of the routine.
- Engagement of people by employees who work in the organisation are the most crucial asset that running the organisation forwards, which by involving them as a part of a decision will be a value mobility of the organisation within motivation and spirit of all employees as becoming a part of organisation movement.
- Process approach is a process of any activity that required input to be processed until it reach to its intention use, which becoming an output that is not only tangible product. All movement that has been done in the organisation is a process that a system created, which leads to the comprehension of inputs from one process come from a different process that interacted with particular care.
- Improvement of the organisation shall be improved continuously by management and circulation of QMS wisely, which by explosion of failure and loop holes may leads the organisation to be succeed.
- A proper management cannot be done properly without evidence-based decision making. If the owner of process or person who is in charge of directing each division in the organisation have no clue on the process, which basing by fact is supporting management of QMS from making a decisions in the organisation.
- Relationship management is required to be observed in certain point of management, another way to improve product or service is suppliers improvement that leads to efficiency and effectiveness of production line to pursue smoothness of the output to be finalised.

(ISO) The standard promoting process approach when it comes to developing, implementing and improving the effectiveness of quality management system and enhancing customer satisfaction by meeting customer requirements in essential approach. Nevertheless, comprehending and managing interrelated processes is a contribution towards efficiency and effectiveness of the organisation by an intended result. The process approach involving systematic definition and management of process such as quality policy and strategic direction of the organisation, which PDCA cycle can be used in various

circumstances by risk-based decision making aimed for taking an opportunity and preventing unwanted result. Furthermore, The application of the process approach to quality management system enables,

- Comprehension and consistency of meeting requirements
- Consideration of processes towards value added
- Achievement of effective process performance
- Improvement of process based on data and information evaluation.

(Maintenance care) PDCA approach is a useful tool in the scientific method of problem-solving regarding continuously improvement, which the four steps approach facilitate the design and enhancement of process and product or service, while cherishing a culture of continuously improvement under risk-based thinking towards their employees. It is crucial to determine the approach on the existed practices and management initiative for optimum results continuously.

To utilising the approach is beneficial especially designing and enhancing new or existing process, product or service, documenting work processes, collecting data to identify likelihood and root-cause of the matter as well as implementing changes towards the organisation. Success of the approach may demonstrate the organisation to improve significantly in process efficiency, customer satisfaction, cost reduction measurement and overall organisation performance. From effectively progress the approach leads the organisation to planning the solution based on accurate archive, small scale test of proposed changes, analysing the result and pursue corrective proactive actions regarding acceptable mean of compliance as well as establishing and comprehending changes to continuously improve.

When extract continuously improvement methodology there are four crucial steps that can be simply explained as,

- Plan as to identifying risks and opportunities of the objective within develop strategies to capturing the issue by analysing data, determining the likelihood and root-cause of the matter and filtering potential positive result. The process might be challenging if information does not support defined goal or objective of the process.
- Do is to implement planned action towards the issue to test their improvement and effectiveness. Common mistake may arise when assignee fail to document their action or overlook a root-cause factor that may affect efficiency and effectiveness of the approach.
- Check is to analyse and evaluate the output of the previous path from an output indicator and other relevant benchmarks, which data analysing is essential to evaluate if the result is acceptable or satisfying the plan, which adjustment or suspension could be launched accordingly.

- Act is a last phrase where findings, notices and result of audit has been analysed, which solution must persuade changes in the organisation by the implementation of changes in the appropriate division and scale.

Nevertheless, Plan Do Check Act cycle has been used commonly in the aviation industry that can be applied to all process of quality management system as a whole, which clauses 4 to 10 can be group to collaborate and co-operate between each clauses by using the cycle to succeed certain task and routine, which illustrated (Figure 3.2) below as,

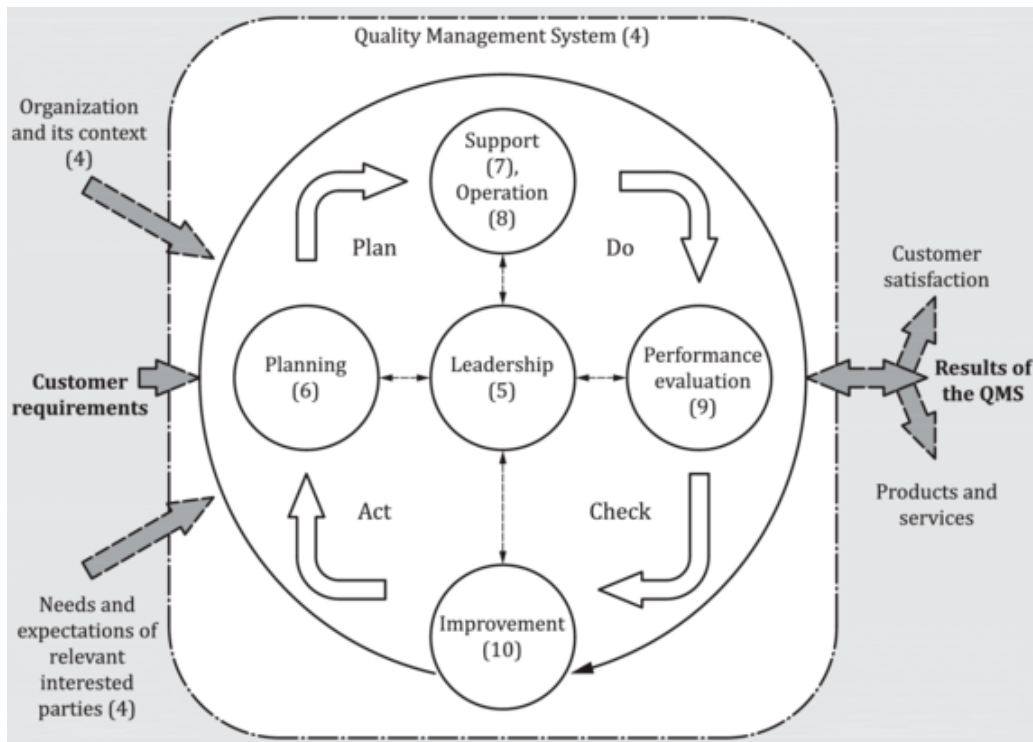


Figure 3.2 Process approach (Numbers in the bracket referred to clauses of the standard)

(Britton, 2019) PDCA is a linear process with start point and stop point. It is repeatable and can be used to identify weakness and goal to continuously improve. There are phrases that need to be analysed in order to utilising the approach in IQSMS such as, planning that involved,

- Identifying weakness
- Understanding root-cause of the weakness
- Identifying solution based on existing tools to address root-cause
- Creating roadmap for the solution towards the matter.

Tools that relevant to apply in the planning state can be shown as,

- Root cause analysis
- Issue life cycle analysis
- Leading indicators.



Once the weakness and root-cause has been identified, CPA or Corrective Preventative Actions must be illustrated, which the information shall be,

- Detail of corrective plan
- Steps to be taken to fulfil CPA
- Assigned person that responsible to comply CPA.

Do is a second phrase of the process that the assigned position must carrying out CPA, which the assignee must expert the matter according to CPA and responsible for reviewing performance with selected indicator.

Check is a third phrase is check, which assignee of CPA responsible for performing checking and evaluating according to CPA performance satisfaction. As a result of it, the outcome of the analysis may reveal as if assignee performance is satisfying the CPA or not, if it does not, the task must be reperform with relevant CPA that aim to extinguished the matter, minimising risk and seeking opportunity out of it after the case has been updated its status from safety manager .

Act is a last phrase where safety manager persuading changes towards operational risk profile that accountable for any risk control and changes on existing process, policies and other relevant objective.

Since changes is sensible to continuously improvement, which management of change shall be wisely consider as communication towards stakeholder and ensuring that the changes that has been made must not irritate or destruct the system itself.

(Maintenance care) Effective problem identification is crucial for an enhancement of the organisation by utilising PDCA approach allows operation to identify their operational issue and comprehend root-cause from data analysis and appropriate tools to solve the problem proactively to continuously improve and gain worthiness towards the organisation. To implement corrective preventative actions can minimise downtime, reduce cost associated with reactive maintenance and improve operational performance by evidence gathered during plan and do phrases. Nature of PDCA cycle is to ensure that continuously improvement has been maintained and obtained in the organisation from previous experiences and risk-based thinking philosophy, while adapting to changes and maintaining safety culture that persuade efficiency and effectiveness towards operation, management, product or service launched.

### 3.2.4 Performance Evaluation

(Hammar, 2016) ISO 9001 mentioning evaluation performance instead of performance indicator, which illustrated in section 4.4.1, where discussing about processes of the QMS, which the organisation has determined criteria and methods to ensure effectiveness of the operation and control including related performance indicators. In addition, throughout the standard there are requirement evaluating performance and effectiveness of QMS. Moreover, in section 9 has justified performance evaluation as an importance of monitoring, measuring, analysing and evaluating the QMS via internal audit and management review. Nevertheless, ISO 9001:2015 has been required the organisation to create solution and time frame to monitor and measure performance and effectiveness of QMS as to progress further analyse and evaluate result. The term of key performance indicator refers to measurement that has been chosen to use as to answer a question of “What should be done in order to acknowledge if QMS performing upon the expectation with continual improvement?”. In addition, this is necessary to the industry that emphasise effectiveness of the product and service. Which to complete this question, monitoring and measuring processes must results what is needed as well as analysing and evaluating results within method used, in order to improve QMS itself. Moreover, below (Figure 3.3) is a KPIs template of ISO 9001 , which can be adjusted to the organisation preferences and illustrated as,

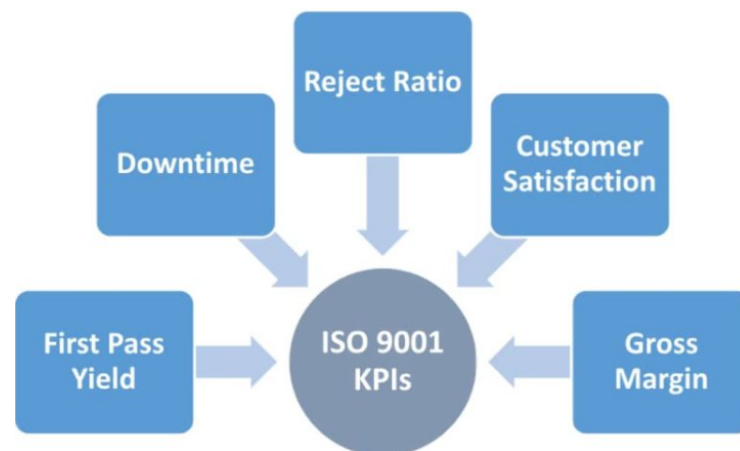


Figure 3.3 ISO 9001 KPIs

Therefore, the illustration described a set of questions and measures to emphasise towards improvement, capability, ability of the organisation under KPIs criteria of QMS as,

- First Pass Yield is what percentage of the product or service is acceptable or give a first time margin when it is created?, if there is a high rework cost, a focus on this might help processes of the QMS.
- Downtimes are difficulties towards equipment maintenance and obstacle towards irregular service?, which downtime could be useful to track and improve of the QMS.

- Reject Ratio is all non-conforming products or services, are there any accepted or expected, which reject and accept ratio could be a point to prioritise in terms of capability and ability of the organisation.
- Customer Satisfaction is one of the most important perspective in term of customer-focused business, which focusing on customer needs and trying exceed it and it is useful to both customer and organisation as well as to not interfere between each other benefit.
- Gross Margin is performance of QMS can be visualised in point of margin that the organisation received or being able to liquidised is another point to be concerns of how QMS is operate, which referred to features and performance of the organisation.

Implement a quality management system that suits the business, It doesn't matter what term used to describe key performance indicator but the most crucial objective is to comprehend how this measurement support the success of QMS. However, it is possible when the system has been circulated for a period of time as by monitoring and measuring, the organisation start getting difficulties of conducting loop holes for improvement, which finding another system to improve the organisation or keep updating system and move with changes are the solution for it. On the other hand, it is depending on the organisation to set up their own needs, which by using this important information to control and improve the processes with Quality management system key elements shall benefit in the long run as well as returns towards the organisation themselves.

### 3.2.5 Schematic representation

(ISO) Schematic representation of a single process is an interaction between the goods that being processed that justified in the systematic order, which monitoring and measuring check point are necessary to control towards process that dealing with risk related and the process is described below (Figure 3.4) as,

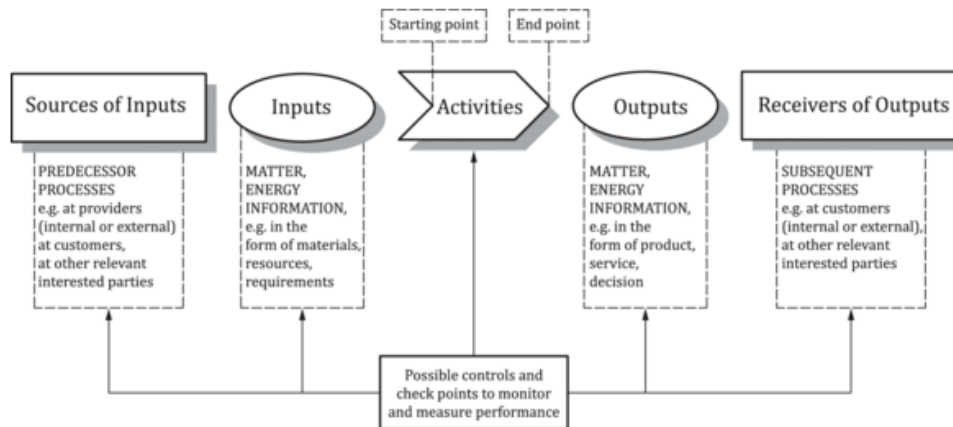


Figure 3.4 Schematic representation of the element of a single process

The schematic has been recapped process from specified order to be made by the organisation that relevant to customer's suitability and preference, which described as when the figure has been shown the element of process and when there are risk related in term of service launch or task remain incomplete, it can simply reassess either failures with the materials, ability, capability of the organisation, supplier and process of task completion, which by any circumstance that may arise, the graph is another tool to illustrate section that expose to obstacles. In addition, restrictions and monitorisation shall be acquired in all sections of the process in order to maintain compliance of service by launch the service under the permission with strict procedures from personnel whom in charge to use materials and equipment towards specific task that has been approved. It can be ensured that quality of the service or product launch to meet customer preference that suits the law and requirements, since each process is depending on situation related to risk.

### 3.2.7 Internal audit

(Hammar) Various companies or organisations has been exposed to required process for internal audit as a form of necessary that shall be maintained in the ISO 9001 registration. Referring to clause 9.2 In addition, internal auditors can be seen as source of internal policies force that protect hiding essential data or misleading with false information that keeps maintaining paths and processes of the system in the organisation. In addition, the standard has been published structure of internal audit, which demonstrated below (Figure 3.7) as,



Figure 3.5 Steps of ISO 9001 internal audit

Moreover, steps of internal audit under the standard can be explained below as,

□ Planning audit schedule

The benefit of scheduling audit that it is readily available, which noticeable by all divisions that auditing is covered in the upcoming cycle. However, if there is surprise audit or random audit, that can be a sign of worthiness towards operation that need to be ensured. By establishing internal audit is meant to support the process, which auditors are there to help or assist in their frame and by gathering valuable information leads to supportation on other planned improvements.

□ Planning process audit

Planning is the first step where auditors have to confirm to process owner or manager in the sector that audit will take place regarding on time to determine suitable period that the audit will taking place. Moreover, auditors can review previous findings or audit result in case of follow-up is required and when process owner can identify arear that auditor need to be

emphasised when the process owner requiring more information. A good audit plan may persuade process owner to receive a good value out of audit process.

□ Conducting audit

An audit should start with meeting the process owner in order to ensure that the audit has been confirmed to start. Avenue may be plenty to audit, which activities during audit are reviewing record, talking to employees, analysing key process data or observing the process in action. The purpose of audit is to gather evidence and information of the processes, if it functioning as planned in the QMS and measuring effectiveness in production or progress towards required results. Valuable things that process owner can gather are the acknowledgements on the point that may lead to malfunction of the process or output and the point that may improve if changes has been made.

□ Reporting audit

A closing meeting with process owner is needed to prevent delayed of information, which the process owner may exposed to information that has to be improved and weakness that need to be address. Following with report regarding on follow-up information, by identifying including nonconforming arears of the process, identifying positive areas and potential area as a future improvement.

□ Follow-up on issues or improvement found

As plenty areas of the standard, follow-up is another required criteria that shall be maintained. If issue is being corrected via corrective actions within prevention of recurrence, which identified by auditors means that the process has been motivated with great improvement.

In fact, ISO 9001 Internal audit can be a wise approach to detailly observe process of the system in the organisation, which supporting improvement and complacency that leads to smoothness and flow with higher efficiency. By utilising internal audit process to improve the processes, maintain compliance and value added the organisation, which purpose of auditing is to improve continuously and it is a crucial element in ISO 9001 Quality Management System that should be one of the organisation motivators to maintain good QMS. Nevertheless, process improvement does not only provide efficiency to the organisation but as well as money and time in the process. If it has been comply properly and wisely, internal audit that being evil in other functions or divisions perspectives can be a biggest contributors towards process improvement of the QMS.

### 3.2.8 AS 9110

(Hammar) Quality management system is crucial in the organisation, since it include all activities that the carrier does to establish their product or service that based by customer focus and necessary criteria to reach to the goal of the organisation in term of providing sustain results to the customer, stakeholder and shareholder, which is a foundation of improvement and growth in the market. In addition, by implementing well known or globally recognised standard must fulfilling customer satisfaction and improvement of the organisation itself. Moreover, the best way to ensure that QMS include all applicable processes under the requirements of the standards that defines and outlines the typical policies, processes, documentation procedures and records that are needed to manage QMS successfully towards the organisation or carrier that adopt and operate the standard strictly from practices of QMS, data management and concentration of customer focus on the quality of product or service launch. Which, there are another standard that being use as a supplement standard of ISO 9001 regarding on requirement of supplement standard of each industry, which can be visualised below (Figure 3.8) as,

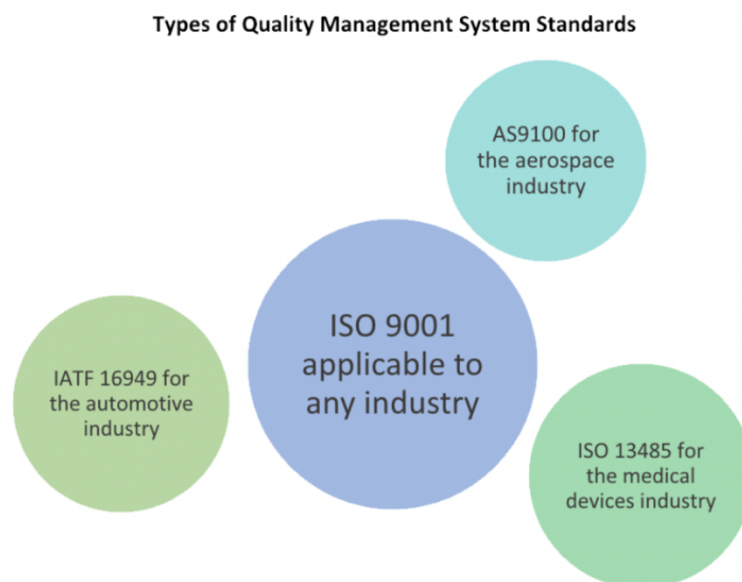


Figure 3.8 Types of quality management system Standard

For instance, other standards that are cooperate as supplement standard such as, AS9100 for the aerospace industry, ISO 13485 for the medical services industry and IATF 16949 for the automotive industry. Moreover, all supplement standards are based on ISO 9001 standard with additional requirements that mandatory on particular industry, which include quality manual as necessary document along with ISO 9001:2015. Quality Management System could be challenging regarding on misconception that the QMS only refers to processes to deal with inspection and disposition of non-conforming products, which designed from quality assurance department, which the system only manages inspection of product when not managing the inputs that influence product or service compliant or quality. In addition, another big challenge that could appear is to demonstrating the

commitment of management such as, having the overlying policies and communication to all level in the organisation, which the QMS can be a method of ensuring that all necessary requirements are defined and improvement has been shown. (EUROLAB) AS 9110 is a standard for quality management system for aerospace industry that developed by International Quality Group Aerospace Industries, which based on or being a supplement standard of ISO 9001 Quality Management System. On this basis, there are special additions has been made in the businesses operating in aviation, space and defence sector. This standard has been established as EN 9100 Aviation series – Quality Management Systems – Requirements and quality systems – A model for design, development, production, assembly and service. For instance, there are two standards that based on AS 9100 standard, which classify as,

- EN 9110 Quality Management Systems – Requirements for aviation maintenance organisations
- EN 9120 Quality Management Systems – Requirements for aerospace and defence distributors.

Furthermore, AS 9110 Quality Management System for Aviation and Space Industry certificate proves that the products and services of the enterprise meets the expectations and standards in aviation, space and defence industry, which provide competitive advantage for the organisation under the adoption and adaption to provide continuous improvement, grow, increase the market share, show loyalty to the main company or carrier and have proven the expertise in the sector. Nevertheless, AS 9100 series are based on the principle of risk management and safety is a prerequisite, which suppliers that operate in this field are expected to operate without failures or errors.

(Kenney, 2022) In 1998, the aviation and defence industry has been established International Aerospace Quality Group or IAQG to improve quality with reduction of cost, which developing specific requirements for aerospace QMS to be implemented and maintain supply chain on design, manufacture and maintenance products used in aviation, space and defence application that based on ISO 9001 that universally adopted. There are different name under the same standard in different title and publication date as AS 9100 is used in the Americas, EN 9100 in Europe, JISQ 9100 for Japan and KSQ 9100 for South Korea in Asia Pacific region. AS 9100 or EN 9100 is the international management system for aviation, space and defence industries that provides suppliers with comprehensive quality management system to fulfil customer requirements and satisfactions, ensure airworthy, safety and reliability of product in aerospace industry. In addition, there are 20,940 certificates of EN 9100:2018, AS 9100:2016, JISQ9100:2016 and KSQ 9100:2018 issued in 14 February 2022 worldwide.

Moreover, AS 9110 or EN 9110 defines requirements for quality management system for the organisation that primarily launching maintenance, repair and over haul services in aircraft industry, which it based on EN 9100 within specific requirements for the maintenance and repair of commercial, private and military aircrafts, In addition, it is a supplement of FAA Part 145 to those repair stations that customer required AS certificate. For instance, there are 832 certificates of AS 9110 including, EN9110:2018 and Society Aerospace Companies or SJAC9110:B has been issued worldwide. Last but



not least, AS 9120 or EN 9120 defines QMS for suppliers and distributors that provide components to supply chain of manufacture products in aerospace and defence industries, which based on EN 9100 with particular requirements for stockist or pass-through distributors. For example, there are 2,312 certificates of AS 9120 including, EN 9120:2018 and SJAC 9120:A standards has been issued so far.

In addition, the table below shows number of aerospace supplier certificates for quality management standards such as, AS 9100, AS 9110 and AS 9120 in aerospace worldwide. Furthermore, there are 24,084 standards worldwide, which 43% in the U.S. and 57% worldwide of AS 9100 or terminology and standard within 832 certificates of AS 9110, which is requirement of QMS of AS standards or 37% in the U.S. and 63% worldwide. The OASIS certification data was conducted from January 2021 to February 2022 and it can be seen that AS certificates in all categories has been increased globally, which illustrated below (Table 3.1) as,

Aerospace Supplier Certifications	Worldwide	United States	% of Global
<b>AS9100:D</b> (including EN9100:2018, JISQ9100:2016, and KSQ9100:2018 Certifications)	20,940	8,921	43%
<b>AS9110:C</b> (including EN9110:2018 and SJAC9110:B Certifications)	832	304	37%
<b>AS9120:B</b> (including EN9120:2018 and SJAC9120:A Certifications)	2312	816	35%
<b>TOTAL</b>	<b>24,084</b>	<b>10,041</b>	<b>42%</b>

Certifications as of 02/14/22

Source: OASIS Database



Table 3.1 Aerospace supplier certifications rate worldwide

## Chapter 4

### Safety Management System of Aeronautic Maintenance Organisation

#### 4.1 Safety Management System in Aeronautic Maintenance Organisation

This section is mentioning safety management system of Annex 19 Chicago convention, Occupational Health and Safety Management System. As well as its module, framework and structure that cooperated seamlessly with complexity of systems to become well prepared information to minimise risk and maximise safety by capability and ability to pursue the tasks together with security from processes and procedures, which are the criteria to result safety quality. (SM ICG, 2018) Safety in an AMO or Air Maintenance Organisation is based by Annex 19 of Chicago convention by ICAO that has been justified a safety management system or SMS to regulate safety management standard and standard practice or SARPs. However, an implementation of the risk management in annex 19's framework is including environmental, security risk, occupational health and safety, which considering as integrated management framework. Nevertheless, safety in Air Maintenance Organisation under State Safety Program is formed of,

- Principle
- Requirement
- Facility internationally.

However, safety performance is maintained at an acceptable level by safety management system and specified outputs are achieved via quality management system. On the other hand, an organisation refers to a product or service provider, operator, business, and company, as well as refers to the regulator authority, Civil Aviation Authority or CAA, National Aviation Authority and any other relevant government agency or entity with oversight responsibility. Safety management systems in aviation organisation are formed of various management systems such as, safety quality, environment and occupational safety. For instance, ISO standards and OHSAS. In addition, air navigation service providers or ANSP's, which leads the organisation to integrate the diversified systems into overall management system. (Roelen & Klompstra, 2012) Safety Management System or SMS has been annexed by ICAO or International Civil Aviation Organisation under Annex 19, which is a managerial process coordinating in two levels such as, state level or authority and service provider. Moreover, state level is responsible to establish a safety program by setting up rules, regulations and activities aimed to improving safety to service providers. In addition, service provider is considered as an organisational level to approve their own operations and allowances. On the other hand, SMS required aircraft

operator, maintenance organisation, air traffic provider and airport operators to comply to the SMS, which acceptable by the state authority with the abilities to,

- Identifying safety hazard
- Ensure that the implementation is a remedy to maintain the agreed safety performance
- Continuously monitoring and complying to regular assessment towards safety performance that aims for continuously improvement of overall performance through safety management system.

SMS shall clearly define lines of description of safety accountability and direct accountability throughout senior manager rolls in the organisation, as well as the framework to implement and maintain SMS in the organisation, which including twelve elements under four components that accepted as the mean of compliance by the authorities and consisted (Table 4.1) of,

SMS framework components	SMS framework elements
1) Safety policy and objectives	1.1) Management commitment and responsibility 1.2) Safety accountabilities 1.3) Appointment of key safety personnel 1.4) Coordination of emergency response planning 1.5) SMS documentation
2) Safety Risk Management (SRM)	2.1) Hazard identification 2.2) Risk assessment and mitigation
3) Safety Assurance (SA)	3.1) Safety performance monitoring and measurement 3.2) The management of change 3.3) Continuous improvement of the SMS
4) Safety Promotion	4.1) Training and education 4.2) Safety communication

Table 4.1 SMS framework of the components and elements

#### 4.1.1 Safety Policy and Its Module

(SMS Pro) Safety policy in SMS defines roles, responsibilities, organisational policy and procedures. Objective of safety policy defined as Aviation Safety Risk Management or SRM must defined policies, procedures and organisational structure to accomplish goals or ensure of continued safety. For example, Safety Policy required roles, responsibility, relationship outlined in policies and procedures. As result of it, the policies must pursue into procedure, which organisational control must ensure that the policies and practice are enforced. In order to follow the safety objectives, software has been developed and used in Safety policy stage to help organisation construct document base and communication module in the requirement of SMS safety policy as,

- Safety Management System Manual
  - Safety Policy and Safety objectives
  - Internal and external auditing procedures
  - Safety investigation procedure
  - References to any applicable regulatory SMS requirements
  
- Job descriptions and responsibilities
  - Publishment of responsible area or authority in the organisation that relevant to the job
  
- Mission Goals and Objectives in safety management system
  - Teamwork and communication milestones
    - Reachable reports and communication platform up to bottom
  - Goal and objective
    - Clear and motivating goals that involved all positions or functions with sense of opportunity, challenge and consequence that collaborate to sense of purpose, which can be seen in real time progress towards achieving company objective.
  
- Organisation Chart
  - Illustration of the hierarchy or the leadership in the organisation
    - Organisation chart communicate the employees on safety relation issues that dealt internally, which the employees can visual a clear cut approach on the concerns up top.

- Safety Policies and procedures
  - Software or web portal within safety statement that is the means of post and manage safety as well as other policies and procedures that employees and other stakeholder can easily access, which allows users to,
    - View organisational policies and procedures via smartphone, tablet, laptop or desktop
    - Easily add and edit policies and procedures from web-based word processor
    - Copy and paste the safety policy or procedures into editor and publish
    - Keep track of last view date for procedures and policies aimed to provide auditors or assurance that policies are regularly viewed
    - Setup automate email review reminders for each policy and procedures with up to two advanced notices before the review of policy or procedures due date
    - Prove to auditors that the policies and procedures are often viewed by audit trail.
  
- Document Manager Brochure
  - Controlled documentation that allows authorised users and viewer to,
    - Share content
    - Document upload and download
    - Adding content securely
    - Search
    - Receive the active notification safety.

Safety and Policy module are involving with the tools that reachable and accessible to all in charge positions and authorised hierarchy as CEO commitment to Safety manual, Safety policy checklist, Safety policy manual, Non-punitive reporting policy manual and safety quiz assessment.

#### 4.1.2 Safety Risk Management and Its Module

(SMS Pro) Hazard risk management the identification, assessment and prioritisation of risk in the organisation, which the process are from economical application of resources to minimise, monitor and control probability or impact of occurrences as well as maximise opportunities.

Risk may exist from likelihood, accident, natural causes and damages by the occurrences, which strategy to manage risk including avoiding risks, reducing negative effect from the risk and accept certain consequences of particular risk.

Safety Risk Management is focusing on hazard identification and the safety risk management process, which it must be ensured that surrounding risks in the operation are controlled. Otherwise, service provider could lose their certifications and permission to operate due to poor risk management. Therefore, strong safety risk management is documentation and the objectives, which include

- Hazard identification
- Risk assessment including probability and severity of risk scenarios
- Implementation and documentation of control measure

In addition, process and systems are form of equipment, human interfaces and client interaction. As the result of it, risk assessment and other relevant procedures are utilising daily in all necessary tasks that the operation performs that is involved to component that necessary to analyse and take steps to improve and solve the case under the module of SRM as,

- Risk Analysis Charts
  - Type of issue
  - Type of process involved
  - Root cause
  - Associated risks and hazard
  - Human factor
  - Mission delays
  - Key performance indicators
  - Status of the issue such open, close or in process
  - Department
  - Division.
- Corrective Preventive Actions or CPA
  - Complying CPA to Risk management scenario
    - An accident is reported
    - Safety or security manager notification

- Preliminary investigation and risk assessment are performed
  - Targeted closure data set to communicate to all personnel urgently to close the issue
  - Safety manager offer or recommend corrective actions and preventive actions
  - Safety manager may recommend their own corrective preventive actions
  - Safety manager assign issue to one responsible manager
  - Responsible manager reviews recommended corrective preventive actions
  - Responsible manager accept or recommended corrective preventive actions or come up with their own solution
  - Responsible manager assigns corrective preventive actions to personnel within the control with deadline
  - Personnel assigns corrective preventive actions to complete task and notifies responsible manager
  - Responsible manager accept or reject performance of corrective action or preventive action
  - If accept, this is the last corrective preventive action before the case is close, which safety manager will be notified once the action has been accepted
  - If rejected, assigned personnel will be notified that the performance has been rejected before reapplying the new actions from responsible personnel.
- Corrective action manager allows manager to monitor corrective preventive actions progress and Identify road block to prevent issues from the closure date deadlines, as well as, allows the manager to review and manage corrective actions in a simple view, which head of the department will be notified via email about the issue. When users complete corrective action, the email will be sent to the head of the department, which manager or head of the department will decided to accept or reject the performance of the implementation of the actions.
- Customer Report viewer
  - Customer report viewer list
    - Investigation
    - Issue flagged by auditor review
    - Portal users contact information
    - All portal tasks
    - Overdue tasks
    - Corrective actions requiring review.

- Data analysis and export
  - Reports and charts
    - Pretty risk analysis charts
    - Useful trend analysis charts
    - Financial risk analysis charts
    - Desensitised accident incident report
    - Performance monitoring charts
    - Key performance indicator charts
    - Normalised data reports
    - External auditor reports
    - Corrective preventive actions reports.
  
- Financial analysis of risk charts
  - Management data and concern issue regarding on safety activities
    - Types of issues
    - Type of processes involved
    - Root causes
    - Associated risk and hazard
    - Key performance indicators
    - Status of case regarding on safety and security concerns
    - Department
    - Division.
  
- Proactive hazard analysis tools or PHAT
  - Operational Risk Profile or ORP
    - Classify reported issues as hazard registration
      - Real time report on performance that leads top risk of operations
      - Automatically notification to require investigation once performance declared of potential risk
      - List hazards by functional category
      - Initial or residual risk assessment
        - Assets
        - Environment
        - People
        - Reputation



- List of control measures and classification
    - Assignment of responsible manager
    - Creation of review schedule.
- Hazard register
  - Registration of hazard and risk associated with the operation
    - Identified hazard
    - Associated risks
    - Initial risk assessment or report
    - Residual risk assessment or report
    - Responsibility manager
    - Date last reviewed
    - Existing mitigation measures
    - Additional mitigation measure.
- Hazard risk management using issue manager
  - Conduction of risk assessment, issue clarification, corrective action management, conduction of investigation
  - Hazard risk management process
    - Report threat, event or regulatory noncompliance
    - Critical assets
    - Risk determination or expected consequence of the occurrence
    - Event classification
    - Approach on risk deduction as a corrective action
    - Prioritise risk deduction based on strategy and implementation
    - Risk communication based on occurrence
    - Data and resources analysis.
- Management of change
  - Management of change only accessible by manager view only
  - Management objective
    - Detailed hazard analysis
    - Structure work flow
      - Adding new route to the operation
      - Operating new type of aircraft
      - Modification of the operation.

- Classification report under risk and management
  - Classification report or all report package
    - Type of issues
    - Human factors or HFACS
    - Business processes
    - Identified proactive hazard
    - Mission delay
  - Issue manager managing risk assessment under classification report by other relevant objectives
    - Issue title
    - Date reported
    - Location
    - Whether issue is proactive
    - High risk assessment
    - Last risk assessment
  - Filter controls by managers under risk assessment within classification report
    - Division
    - Start date for issue reporting
    - End date for issue reporting
    - Type of concern such as, Safety, Security, Quality, Compliance or Environmental
    - Key performance indicator relevant to performance of the risk assessment.
  
- Risk impact trending chart and investigating trends
  - Concept of collecting information and attempting to spot a pattern in terms of safety, security, quality and compliance
  - Trending charts in number of issues by year and month
    - Type of issue
    - Root causes
    - Type of business process.
  
- Safety risk management tools
  - Safety manager checklists
  - Safety management style
  - Risk management procedures and Management of change checklists.

### 4.1.3 Safety Assurance and Its Module

(SMS Pro) Safety assurance is another leg of SMS or safety management system in the organisation that mandatory, which playing roles of ensure policies, controls and assessment of the functions and features that applied into air navigation services provider. Its objectives are ensure that aviation service providers are continuously practice the safety program and other relevant systems, and objective of the organisation even when the operation environment has been changed. Safety assurance concerns of quality management system that associated and integrated to safety management system. Furthermore, continuously monitoring is the task of SA or safety assurance that strengthening the SMS, which monitoring internal and external systems, which allows to detect changes as, new safety risk and existing control measure that leads to loss of effectiveness. In addition, continue monitoring activities including hazard reporting activities, internal audit, external audits and regularly reviewing regulatory requirements. Moreover, corrective and preventive actions including report of issues and audit findings are relevant to safety assurance that both actions must be managed by responsible managers in safety assurance for affected operational areas. Safety assurance is an organisation effort team to ensure safety and quality in the organisation towards activities that operated. As implementation of SMS is integrated between safety and quality programs into one single system, which controlled by safety assurance of effectiveness and efficiency in the practice of operation and there is safety assurance modules that necessary to safety assurance as,

- Audit suite
  - Auditing dashboard, history and record
  - Audit Scheduler and Calendar
    - Scheduling time or recurring audit
    - Inspection form to audit
    - Elements of form that necessary to audit
    - Assigning audit in division and location
    - Manage auditing team performance
    - Notifying upcoming auditing task and details about audit
  - Auditing Tool
    - Auditing platform to questioning other audit member in terms of finding form to identify finding and concerns over the case, which attachment can be added to response each of question
    - Notification of complete assignment to head of the department to review before accepting its completion
    - Auditing form also available in application, website or other platform that the organisation use as well as in offline version

- Finding Manager
  - Managing findings
  - Allowing managers to assign findings in different divisions and update auditors with CAP or Corrective Action Plan
  
- Audit Reports
  - Auditing form is depending on the authority, safety assurances, system or module that the organisation comply to as,
    - BARS or Basics Aviation Risk Standards
    - CASS or Continuing Analysis and Surveillance System
    - FAA 5280.5C
    - IOSA or IATA Operational Safety Audit
    - ISAGO or IATA Safety Audit for Ground Operation
    - ISSA or IATA Standard Safety Assessment.
  
- Security Officer Checklist or Checklist manager
  - Routine task based by Human Factor Apathy and complacency
    - Safety drift
    - A hazardous condition
    - Safety management
    - Continuous bias
  
  - Security officer checklist manager
    - Scheduled on recurring basis
    - Concerns in checklist format
    - Necessary documents regarding task to observe
    - Safety report when required
  
  - Security officer checklist under QSMS or quality safety management system
    - Safety task routine checklist
    - Quality task routine checklist
    - Integrate subtask that satisfy quality and safety as indivial item.

- Gap analysis
  - Internal safety audit
    - Policies
    - Organisation
    - Hazard identification systems
    - Investigation capabilities
    - Record management
    - Analysis capabilities
    - Regulations management
    - SMS documentation
    - Risk management
    - Safety goal and objectives
    - Safety promotion, training and education.

Internal auditing regarding safety and quality towards the organisation does have general base assessment criteria to score after auditing but in each organisation might be more complex depending on an organisation capacity and ability as shown by the table below (Table 4.2) as,

Score	Assessment	Details
0	No Action	No Action has been taken on this required element.
1	Action Initiated	Identified actions have been taken to meet the requirement but the actions are not complete.
2	Implemented	Identifiable actions are satisfactory to meet this requirement and are observable in policies, procedures, organizational actions, and employee actions.
3	Integrated	This required element of an SMS has been integrated with other SMS elements and requirements within the organization.
4	Evaluated and Sustained	This required element has been integrated with other SMS Elements. Additionally, this element has been subjected to at least one prior round of evaluation/audit and there is evidence that the required actions have been sustained over time. Further, there are no identifiable reasons why sustainment should not continue.
5	State of the Art	Conformance with this requirement of the standard is considered state of the art; they could be used as a benchmark for other organizations to use.

Table 4.2 Internal audit safety criteria

- Hazard and risk exposure is based on likelihood of the event, which potentially lead to hazard either lightly or severely. 5 phrases of safety risk management process has been commonly used in order to analyse level of risk before mitigate the risk that can potentially become hazard as,
  - Phrase 1; To understand and describe the system
  - Phrase 2; Identify potential hazard
  - Phrase 3; Determine the risk in level
  - Phrase 4; Assess the risk in level
  - Phrase 5; Treat the risk either mitigate, monitor or tracking actively if necessary.

Nevertheless, hazard risk can be justified under level below as,

- Management and tracking are required to pursue mitigation controls over high risk hazard
- Tracking and manging are required during medium risk within acceptable level of risk hazard
- Low risk hazard level are not require management and tracking but only to document the case.

In addition, hazard identification in any event shall be justified under below criteria as,

- Hazard assessing by Risk matrix regarding on probability and severity
- Estimate annual cost by using Assessed Cost Per Occurrence multiply by frequency per year of risks and hazard category
- Hazard is assigned to responsible manager within representative as well as review cycle
- Continuously check-up within mitigation measures towards each hazard to minimise risk to the operation
- Residual Risk Assessment will be used to determine probability to mitigation strategy in term hazard risk deduction
- Recovery measures are prepared once the hazard has been occurred.

Hazard and risk exposure module as risk mitigation report and issue reported by risk level Hazard described as an existing or potential condition that is prerequisite to an accident or incident, which leads to injury, illness or death to people, damage or loss of system, equipment and property as well as damage of the environment.

- Monitoring safety performance or KPI trend monitoring from ICAO has been setting minimum standard as the operators such as maintenance organisation, airlines and airports must comply to continuously monitoring through regular assessment, which under KPIs safety performance indicator management leads to greater management towards closing the organisation risk gaps. Key performance allows responsible top manager to view the safety implementation in an organisation that clearly shown an obstacle to improve continuously. Measurement of safety performance are form of reports of risk hazard, auditing findings, loss time and injuries with other relevant matters regarding on safety. On the other hand, key indicators of safety culture are being analysed on visiting of CEO, number and attendance of relevant divisions, near missed report and effectiveness and efficiency of implementation and performance of safety culture, which associated to numbers of days took to close the issue or report, numbers of investigation as well as performance of strategy that approach to the operations. Nevertheless, considerations of monitoring safety performance are form of,
  - Hazard reporting
  - Risk management
  - Cost
  - Time to close issue
  - Trending charts
  - Tables and percentage of performance under safety.
  
- In addition, performance management indicators are form of,
  - Total number of issue reported
  - Days to resolve issue
  - Reporting frequency monthly
  - Average number of issue report monthly
  - Total cost of all issues
  - Average cost per issue
  - Minimum issue cost
  - Maximum issue cost.

- OHSAS or OHSMS
  - OHSMS module that concerns on employees health during operation of tasks.
  
- Predictive analysis
  - PAT predictive analysis tools
    - Data of general performance, warehouse, equipment, reports of the organisation in all departments, which predicting gaps in the organisation that leads management sector to close the gaps in order to minimising potential risk and hazard that remain quality in the organisation.
  
- Safety case or archive in the organisation that focusing on hazard during operation shall be kept in details below as,
  - Introduction and management summary
  - SMS description regarding on safety case
  - Critical activities catalogue
  - Safety case regarding on operations
  - Hazard and effect management
  - Remedial action plan
  - Conclusion and statement of the case worthiness.
  
- Safety training and qualification resources
  - Safety training resources
    - Employees
    - Employees role and position
    - Training courses
    - Qualification of courses
      - Initial
      - Renewal.
  
- Implementation plan
  - Structural approach to guaranteed of SMS implementation
    - National and regional authority implementation plan in four phrases as implementation plan.



- Vendor, service launcher to another company or suppliers management
  - Hazard identification and quality of the supplier or vendor to organisations
    - Vendor message acknowledgement
    - Vendor evaluation checklist.
  
  - Supplier management module
    - Vendor or supplier details
    - Supplier service type
    - Supplier references
    - Supplier contact or agreements
    - Supplier evaluation as internal auditing for supply
    - Supplier assessment for sample and performance of supplier
    - Incident and accident report regarding on supplier.
  
  - Vehicle/vendor report
    - Reported issue regarding on safety and quality of supplier, equipment, vehicle and material.

#### 4.1.4 Safety Promotion and its Module

(SMS Pro) Safety management system is accountable to executive or top manager down to all employees in the organisation, safety promotion is a value practice to promote safety culture. Its activities begin with implementation of top management down to all employees and consisted of,

- Safety culture enhancement
- Training and education
- Sharing safety goals and objectives
- Safety communication
- Data supporting implementation of SMS towards the organisation.

In terms of succeeded safety promotion in the organisation, there are modules that helping operation, which safety promotion have several modules or platform that used in order to achieve safety promotion activities as,

- Aircraft / Airport status board
  - Status and notification of airport, aircraft
  - Reports of safety regarding on airport and aircraft.
  
- All employees letter
  - Details of implementation plan and management commitment to safety management system

- Example of All employees letter is illustrated by the picture below (Figure 4.1) as,

## To All World Aviation Employees:

On February 22, 2008, World Aviation will begin implementing an organization-wide aviation safety management system (SMS). All employees are required to participate.

World Aviation will implement this SMS using FAA's suggested "**SMS MATURITY MODEL**". Initial implementation strategy will follow the four phases outlined in the ICAO SMS training course (as of September, 2007).

The phases of implementation will be arranged in the format of a maturity model, similar to that developed as the Capability Maturity Matrix (CMM) by the Software Engineering Institute of Carnegie-Mellon University. This technique has also been employed by the U.K. Health and Safety Executive (HSE – equivalent to U.S. OSHA) as a safety culture maturity model.

**Level One:** Planning and Organization. The first step in development of the SMS is for the organization to analyze its existing programs, systems, and activities with respect to the SMS functional requirements found in Appendix 1 of AC 120-92. For this reason, the analysis is called a "gap analysis," the "gaps" being those things in the standard that are not already being performed. Once the gap analysis has been performed, an implementation plan is prepared. The company organizes resources and assigns responsibilities and sets schedules and objectives.

**Level Two:** Reactive Processes. At this step, the organization develops and implements a basic risk management process. Basic information acquisition, processing, and analysis functions are implemented and a tracking system for risk control and corrective actions is set up. This allows the organization to react to problems as they occur and to develop appropriate remedial action. For this reason, this level is termed "reactive." While this is not the final objective of an SMS, it is an important step in the evolution of safety management capabilities.

**Level Three:** Proactive Processes. Clause 5 of the SMS standard requires safety risk management (SRM) to be applied to initial design of systems, organizations, and products, development of operational procedures, and planned changes to operational processes. The activities involved in the SRM process involve careful analysis of systems and tasks involved, identification of potential hazards in these functions, and development of risk controls. The risk management process developed at level two is used to analyze, document, and track these activities. Because the organization is now using the process to look ahead, this level is called "proactive." At this level, however, these proactive processes have been implemented but their performance has not yet been proven.

**Level Four:** Continuous Improvement. The final level of SMS maturity is the continuous improvement level. Processes have been in place and their performance and effectiveness has been verified. The complete safety assurance process, including continuous monitoring and the remaining features of the other SRM and safety assurance processes are functioning. A major objective of a successful SMS is to attain and maintain this continuous improvement status for the life of the organization.

Again, participation in World Aviation's SMS is mandatory.

Sincerely Yours,  
Top Management  
1 February 2008

Figure 4.1 Example of all employees letter

- Safety article training library allows an organisation to prepare SMS training towards their employees that are form of,
  - Educational safety training articles

- Promoting aviation safety articles via message board by manager to relevant employee
- Training library category
  - Security
  - Human resources
  - Dangerous good
  - Educational training
  - Additional categories
  - Edit and limit access through articles SMS admin or manager
- Tracking employees on recurrent training activity
  - Reports of managing employees training and qualification by document
    - User reports for individual employee to monitor progress
    - Company report by relevant division or department
- Meeting manager module
  - Document for meeting regarding safety issue towards safety team
    - Issues
    - Corrective actions
    - Preventive actions
    - Agenda items
    - Notes or remarks.
- Message board
  - Communication board is a method to documenting an acknowledgement and communication in the operation that form out of,
    - Aviation safety related to policies and procedures
    - Important safety announcements and notices
    - Compliance statements
    - Audit trial items
    - General Communication.
- Material safety data sheets or MSDS
  - Digitalised material safety sheet to be acknowledged in order to avoid harm out of product used in the operation.
- Safety newsletters for safety promotion activity
  - Newsletter of existing safety concerns and particular events occurred in the organisation
    - Organisational safety goals and activities
    - Hazard

- Increase of awareness regarding to incident and accident
    - Special safety training
    - Routine safety meeting
  - Purpose of safety newsletter
    - Informing
    - Announcing
    - Reminding
    - Instructing.
- Safety culture survey
  - Safety survey to support safety culture and quality improvement as well as,
    - Raise employees awareness regarding on safety and quality issue
    - Diagnose and assess existing safety culture
    - Identify safety culture improvement
    - Examine safety culture trend cultivation
    - Evaluate cultural impact of safety initiation regarding on attitude of employees
    - Conduct internal and external comparison
  - Safety survey purpose
    - Receive feedback of safety and safety culture towards all employees
    - Generate awareness of safety program
    - Educate all employees on safety agenda
    - Increase management concerns of safety.
- Induction training process
  - Prove of external auditors
    - Comprehend how safety management system operate
    - Being aware of role play in SMS
    - Comprehend SMS aim as to improve safety not to attribute blame
    - Participate to formal or informal induction or initiation of SMS
  - Induction training
    - Requirement of policies and procedures are in web base or software
    - Review of safety policy
    - Review CEO commitment to safety
    - Comprehend how to report issue
    - Review policy regarding of types of issue to report
    - Understand organisation chart and its safety goal within used safety software
    - Mutable document or changeable document to train of requirement objective.

## 4.2 Safety Culture

(Roelen & Klompstra, 2012) Safety culture is another essential in the organisation regarding to Safety management system but not being clear in terms of safety health culture. Furthermore, based by European commission that complemented by EASA as Regulation (EC) No 216/2008, promotes the concept of safety culture, which required incidents and occurrences to be reported in the operation or working procedures, which created a non-punitive environment and anonymous report to the one who reported it. On the other hand, in aviation there is no enforcement on safety culture in the management and operation system, except Performance Scheme Regulation, which amended in European Commission in 2010 and requires implementation of safety culture and measurement level to presence and absence the culture in the state level to an Air Navigation Service Provider without a clear definition of safety culture but within tools.

There is no exact definition regarding on safety culture in the organisation but to review existing safety culture in aviation resulted as safety culture is the set of attitude and objective regarding on safety issue that shared among the organisation in all level or positions that positively committed to safety. For instance, consistently evaluate safety related behaviour, willingness to communicate regarding to safety issues, being aware in activities that may create risks and unknown hazard, being able to adapt themselves when facing safety issues and continuously behaving safely in order to maintain and enhance safety. Safety culture has been developed and cultivated through aviation industry by providing framework and safety culture assessment tool, which called Aviation Safety Culture Inquiry tool or ASC-IT. This system aimed to assist organisation with assessment and management of the safety culture in the entire aviation industry to all levels, which applicable to operational sector or ANSP and non-operational sector or management sector. ASC-IT is consisted of 6 characteristic and culture indicators, which showed in the table below (Table 4.3) as,

Safety culture characteristics	Safety culture indicators
1) Commitment	1.1) Management concerns 1.2) Personal concerns 1.3) Investment in safety
2) Justness	2.1) Evaluation of (un)safe behaviour 2.2) Perception of evaluation 2.3) Passing of responsibility
3) Information	3.1) Communication of safety related information 3.2) Safety training 3.4) Safety reporting system 3.5) Willingness to report 3.6) Consequences of safety report
4) Awareness	4.1) Awareness of job induced risk 4.2) Attitude towards unknown hazards 4.3) Attention for safety
5) Adaptability	5.1) Actions after safety occurrences 5.2) Proactiveness to prevent safety occurrences 5.3) Employee input
6) Behaviour	6.1) Job satisfaction 6.2) Working situation 6.3) Employee behaviour with respect to safety 6.4) Mutual expectations and encouragement

Table 4.3 Safety culture characteristics and safety indicators

Moreover, Eurocontrol and FAA had justified the integration between SMS and ASC-IT or QMS as safety management system leading the organisation to achieve safety but required safety culture as a commitment to achieve safety. Therefore, integration between both systems can be illustrated under the cooperation of it as,

□ Commitment

- Management commitment and responsibility of SMS is processes and procedures in safety policy and objectives component or management level on how commitment of SMS can be achieved. On the other hand, commitment is a framework of safety culture that trained participants or employees to have positive attitude and behaviour towards the recognition, comprehension, adapt and adopt of safety policy and objectives that visualised in SMS.

- Justness
  - Safety culture is requirement that SMS must obtain from section 3.3.7 of ICAO 2010a, which protecting flight or aircraft data or record and report to be non-punitive or does not being punished if the occurrence can be proved that there is no intention of committing, as well as voluntary incident report from section 8.3 and App. E in ICAO 2001. Safety policy does requires clearly indication of unacceptable operational behaviour type for further analysis and improvement, which the protection by safety culture unlock the organisation to pursue so.
  
- Information
  - Safety promotion does include safety training and education within safety communication does not in charge the protection of information, which it is safety indicators but it is essential for the information to delivered in order to analyse and improve continuously by SMS
  
- Awareness
  - As from upper to lower must being aware of the activities in the organisation from management to operation to prevent known or unknown hazard that might occur and close the gaps of likely hood, which as high level of awareness is a character of proactive approach that support SRM or safety risk management as hazard identification and SA or safety assurance component as continuously improve of SMS, which safety culture leading the organisation to maintain such safety standard in terms of awareness.
  
- Adaptability
  - Adaptability in safety culture allowing and fulfilling safety procedures by human input to pursue reactive approach in SMS as to learn from past experiences and take possible actions to enhance level of safeness as well as complying proactive approach as to be aware of any possible hazard that can occur and solving safety matter by an encouragement of improvement that suggested. High level of this safety culture, it provides efficiency to support SRM or safety risk management in SMS.
  
- Behaviour
  - An SMS may describe operational behaviour in the official hand book. However, by this criteria or characteristic of safety culture describe and justify necessary behaviour on safety including value such as peer and superior, which in this it is reflecting all positions top to bottom to behave and maintain level of appropriation towards operation in terms of safety.



Majority of safety culture characteristics and indicators are cooperated with SMS components and elements but in different perspectives. For example, safety culture is enforcing employees to pursue reactive and proactive approach towards operation, while SMS is enforcing standard on procedures and processes in the operation. Furthermore, safety culture giving mobility to SMS to perform with higher efficiency and effectively. On the other hand, with efficient and effective procedures, processes, documentation and proper communication leads SMS participants or employees under SMS with higher safety attitude and willingness to improve continuously towards operations within positive influence on each other employee in the organisation.

### **4.3 Safety performance evaluation**

(Roelen & Klompstra, 2012) The problem of measuring safety performance or evaluation towards aviation industry has been discussed for at least 50 years, which traditionally accident rate was used to measure aviation safety performance and when safety was increasing continuously, accident became rare event, which a larger statistical based was required. On the other hand, ISO has been justified the definition of safety as the freedom of unacceptable risk, where risk is a combination of the probability of harm occurrence and severity of the harm. In addition, harm is physical injury or damage to health of people directly or indirectly, which resulted as a damage to the property and the environment. As the result of this definition, it is mandatory to subject safety, since it might not be acceptable to all of the people in the organisation, which it is difficult to measure safety performance because absence of harm does not guaranteed the absence of risk.

ICAO has described severity of harm in aviation safety as an accident or occurrence that results to fatality, serious injury and damage to the aircraft. It can be determined that aviation safety is an absence of unacceptable accident probability or likelihood and safety performance can be described as the accident probability, which aviation safety performance indicators should provide an indication of the probability of an accident. Furthermore, ICAO justified an incident that associated with operation of the aircraft that could interfere operation safety, which can be determined as an occurrence or an event that resulting unintentional harm. On the other hand, by definitions of accident and incidents, which regarding of negligence operation that interfering flight safety, Heinrich et al 1980 has been illustrated accident chain model in order to increase the comprehension on safety performance and sustain the organisation to manage and maintain safety as, comparing the accident into the line-up dominoes within the analysis and revealed as accidents are form in two types as unsafe act and unsafe condition, which by removing one of the intermediate dominoes and the remaining one would not fall and the injury will not occur. As the result of it, by removing threat or control prioritised likelihood may not create injury and damages towards the operation. On the other hand, Safety performance can be described under Heinrich et al 1980 as the numbers of dominoes that have fallen, the likelihood of all dominoes falling

over is higher, which means that as more of likelihood regarding unsafe condition has occurred, risk of unsafety is higher. In addition, safety indicator is considered under this theory and by minimising the risk by complying to safety act and condition will maximised safeness of operation.

A cultivated theory in terms of unsafe act and unsafe condition by accident is a situation that latent failure, which arising mainly in managerial and organisation sphere, which combine with local trigger events or weather, location and other relevant environment together with active failure of individuals in operation level. In addition, latent failure is existing failure that occurred in period of time before accident or illustrated as each slides of cheese representing barrier in different organisation level, which holes existed in it representing failure barrier or likelihood and once the holes are align to all slides of cheese accident will occur. By using this theory it can be determined safety performance in the organisation on how it conceal the hole on each slides of cheese. On the other hand, it is necessary to involve other systems that existed in safety management systems to justified how well the safety control functioning as well as emphasised undesired outcome of the event. Last but not least, the difficulty of various leading indicators are the association to the organisational or managerial to quantify and justify accident risk in terms to pursue appropriate steps and improvement.

Characteristic of an acceptable safety performance can be,

- Quantifiable and permitting statistical probable procedures
- Valid or representative to be measured
- Provide minimum variability when measuring the same condition or occurrence
- Sensitive to change in the environment or behaviour condition
- Cost of using to measure is consistent with the benefit
- Comprehended by all levels or positions that in charge or take responsibility on using it.

Moreover, the International Atomic Energy Agency or IAEA has adding that the accuracy of data shall be capable in quality control and total set of the indicators should remaining to managerial. On the other hand, there are several potential problems the indicators above as that is composite indicators and unneutral, which does not fulfil the requirement of safety performance indicators and not clear if the indicators were deduce by systematic process and cooperate to risk control process. In addition, by manual reporting system, there is a high risk of underreporting, since not all levels are report appropriately or willing to report.

#### 4.4 Occupational Health and Safety Management System

(EUROLAB) From all warnings, precautions, countless occupational accidents that kills and injured people globally, Occupational Health and Safety Management has been satisfying the organisation to reduce risks of lost in the organisation and improve safety towards their employees when they are operating their tasks or daily routines. Communities have a safety culture to raise their employees awareness under the operation with risk of health as to protect, maintain and improve health of the employees under the safety standards across the organisation. When occupational health and safety has been mentioned, it refers to the whole competencies, behaviour patterns, value and attitudes that determining safety practices of the organisation or enterprise. Therefore, occupational health and safety culture is accomplished by publishing the standard policies at the national level, participate international conventions, complying the regulations of the standard to raise awareness in organisation environment. The ISO 45001 is a managing system that ensuring the comprehension of continuous improvement in the business by occupational health and safety policies, planning, implementing, control and corrective actions together with management review. Furthermore, the occupational health and safety system fills the gaps of systemising the occupational health and safety management system in the organisation, increasing general performance, complying with required regulations, demonstrating an involvement of the employees throughout the organisation and being transparent about social responsibilities of the carrier. ISO 45001 is the international standard for OHSMS that integrate OHSAS 18001 by existed requirements and content as a predecessor. In addition, ISO 45001 standard adopts the Annex SL top-level framework of all new and revised ISO management systems standards that aligned with ISO 9001:2015 and ISO 14001:2015, which published on March 2018. In addition, the framework of ISO 45001 can be comprehended as,

- ISO 45001 is concentrating on stakeholder expectation of occupational health and safety management and comprehension towards crucial issues that may leads to positive or negative effects to the organisation and how it manages occupational health and safety towards their employees. On the other hand, without an efficient and effective management and policy commitment of OHS that meeting the purpose of OHSMS, it could interfere the ability of the organisation to produce an intended product or service.
- Leadership is engaging with OHSMS via direct participation and OHS performance from a strategic planning to achieve an effective OHSMS within directing, managing, supporting and communicating to workers and promoting the organisation with safety culture. In addition, this standard clearly defines top management responsibility and accountability in occupational health and safety management. This is to ensure that top management may taking full responsibility and not being delegated by other managers in the organisation.

- Participation or consultation required top manager to encourage their employees as their representative by being a key factor of OHS management. Furthermore, consultation is a two way communication with dialogue and exchange or from speaker to receiver that in charge of timely information between employees and top management before making a decision. The OHSMS is reply on participation of the employees throughout the organisation that engage operation and top management together regarding on risk based decision making by purposed changes feedback form in the organisation. Therefore, the enterprise must encourage their employees at all levels to report hazardous situations to utilise preventive measure when corrective actions has been taken, which employees shall be able to report and suggest areas of improvement within confidence with protection of the information and employee who reported.
- Risk based approach on OHSMS is focusing on the context of the organisation that enforcing to adopt risk based approach when developing and implementing OHSMS, which the carrier must identify risk and opportunity of utilising OHSMS to accomplish intended result within evaluation of effectiveness of the processes and performance under the operation.
- Outsourcing is required in the standard as to ensure the outsource processes influence OHSMS to be controlled and defined, which when outsourced product or service supplied the organisation that coming with risk that must be emphasised and managed relationship and effectiveness between the supplier and the carrier.
- Documented information has been used instead of documented record. In addition, evidence from processed information is now accepted to be in a formal document system such as, electric information on smartphone or tablet.

#### **4.4.1 Requirements of ISO 45001**

(ISO UPDATE, 2018) Under ISO 45001 require an organisation to create context of the organisation that comprehend the entire environment of the carrier operates internally and externally. Therefore, by utilising SWOT and PESTLE Analyses helps determining an environment of the organisation inside out that are necessary data towards management and position of the carrier in the existing market of the industry. On the other hand, the organisation is requiring to create internal and external issues that influence output of the occupational health and safety management system positively and negatively that including, conditions, characteristics or changes via circumstances that affect the OHSMS. For instance, external issues that shall be considered can be form of,

- PESTLE analysis (Political, Economic, Social, Technological and Environment factors

- Competitors, contractors, suppliers and partner analysis
- Product knowledge and its ability under OHSMS
- Trend analysis of the industry
- Relationships between organisation and external interested parties
- Changes regarding on above factors.

On the other hand, internal factors that the organisation should determine, which leads the organisation to be healthy internally as to know how the carrier stand and the factors are possible be,

- Organisation structure and responsibilities
- Policies and objectives
- Capabilities of resources in the organisation such as, human and technology
- Information system
- Relationship between top management and operation levels
- Contracture relationship of outsource activities
- Working conditions and organisational culture
- Working schedule and time arrangements
- Plan of changes in products, processes and equipment
- Plan of changes regarding on above factors

In addition, the carrier shall consider needs and anticipations of interested parties and employees that are relevant to the operation the OHSMS in the organisation. Interested parties may be legal and regulatory authorities, main carrier or parent organisation, suppliers, contractors and subcontractors, workers representative, workers organisation or association as trade unions and employees, customers, medical or community services, media, business associations, NGO and occupational health and safety organisations and practitioners. Moreover, needs and expectations are supposed to be incorporated or associated with applicable laws and regulations, which are mandatory. If there are voluntary requirements that the organisation comply to, the carrier must address needs and expectations of it under the operation under OHSMS regarding on planning and implementation.

#### **4.4.2 Scope of ISO 45001**

Nevertheless, the scope of OHSMS shall define its boundaries and applicability as well as interested parties need and expectations in the performing tasks or activities which, the boundaries are mentioning about whole organisation or specific division and the scope must not evade or against the laws and regulations. As the result of it, the activities that affect OHSMS and its performance shall be maintained as documented information. The organisation or enterprise must implement, maintain and continually

improve OHSMS regarding requirements of ISO 45001 and establishing one or more processes that fulfil requirement of the standard together with implementation of those processes and control of the anticipated outcome. The organisation shall integrate and incorporate requirements of this standard into the protocol of the organisation processes such as, design, development, procurement, training, education, human resources, sales and marketing.

(45001Store, 2019) To uplift a comprehension of the certification, in section 04 of the standard has explain context of the organisation, which form of various sections that described as,

First of all, section 4.1 of the standard has explained organisational context which, is relevant to consider the factors externally and internally from an implementation of the system among the operations between additional customer, economic and competitive factors in order to realise and understand the surrounded environment that is providing a movement in the business. Nevertheless, the section is requiring management or execution wisely towards health and safety policy and human resources as well as governments, associations, unions and regulators.

Second of all, section 4.2 is an expectation and needs between workers and other interested parties that could impact the tasks and who committed, which those who migrated to ISO 45001 certification to have a constant system to consider mentioned influences or factors.

Third of all, section 4.3 is the scopes of OHSMS as what parts of the workplaces associated with plant or factory and office or administration that are included in the system. Once the scope is defined, the organisation must involve the activities, products and services that controls or influences performance of the system.

Section 4.4 OHSMS of an the organisation must establish, implement, maintain and continually improve the system that including the processes with its interactions according to ISO 45001, which shall be decided by the organisation hoe the system can fulfil the enterprise. In addition, the requirement of the standard include level of detail that can be extended as,

- Integration of OHSMS into various business operations such as, design and development, procurement, human recourses, sales and marketing and other relevant sections.
- Incorporate or including the issues associated with context 4.1, its interested party requirements based by context 4.2 and scope of the system based from 4.3.
- Usage of policies and processes that developed by other part of the carrier such as, corporate OHSMS policies, document management system, competency programs, procurement controls and other relevant area.
- Process of the document should be operate properly including updates, which involved by all positions in the organisation.

Beside clause 4 or context of the organisation of ISO 45001, there are other mandatory clauses in the standard, which can be illustrated below (Figure 4.3) as,

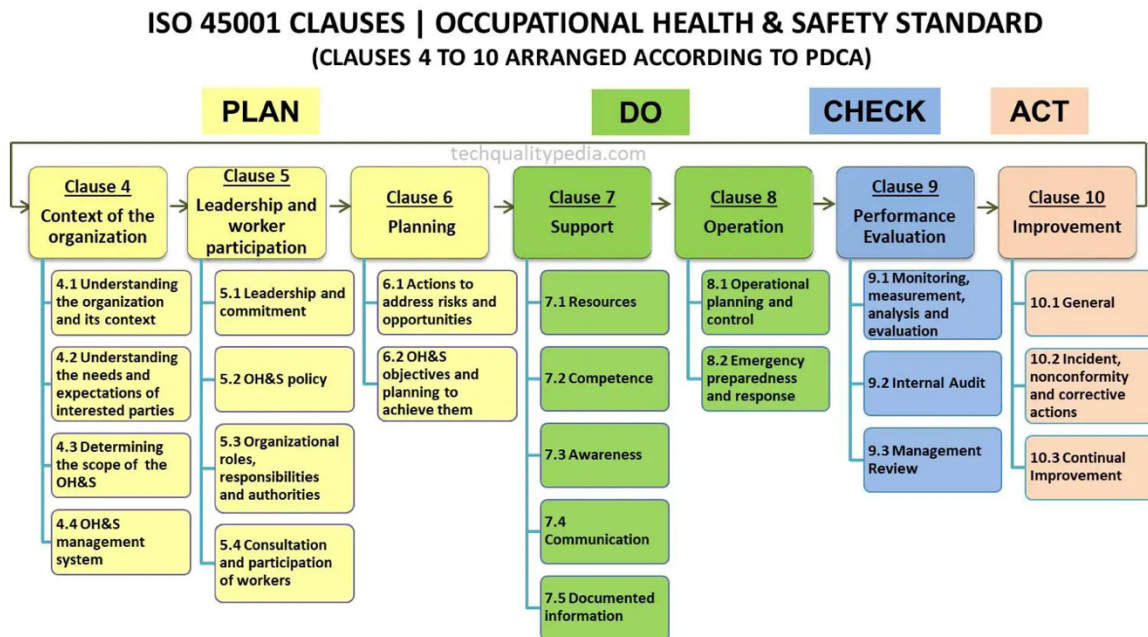


Figure 4.2 ISO 45001 clauses 4 – 10 according to PDCA module

#### 4.4.3 Guidance of ISO 45001

Nevertheless, (ISO) the organisation is responsible for occupational health and safety of their employees and other relevant parties that affect to the activities, which to promote and protect their physical and mental health. By the adoption of the system, it enables the enterprise to maintain their health in workplaces, prevent work-related injury, illness and continually improve the system performance. Moreover, purpose of this is a framework of risk and opportunities from implementing and managing the system that is providing safe or with as less as possible damage or injury. It is crucial for the carrier to eliminate hazard and minimise risks by utilising preventive and protective measures. Therefore, an effective and efficient system can be seen when an action has been taken early or on time as well as assistance with other systems that has been integrated in the organisation. The implementation of the system is a strategic and operational decision of the organisation that depending on objectives, elements and management of the system. Such as, leadership, commitment and participation from all positions. In addition, its effectiveness and ability to succeed the intended outcome are rely key factors that illustrated below as,

- Top management, leadership, commitment, responsibilities and accountability
- Top management shall developing, leading and promoting a culture in the organisation, which supports an intended outcome of OHSMS
- Communication

- Consultation and participation of employees towards their existence as a representatives of the organisation
- Allocation and maintenance of the necessary resources
- OHSMS policies are compatible to be an overall strategic objective and direction of the organisation
- An effective process shall identifying hazards, controlling OHSMS and taking advantage of the opportunity from the system
- Continual performance evaluation, monitoring of the OHSMS and its opportunities
- Integration of the systems towards organisation progresses
- Objectives that aligned with the safety policy should accounting hazard, risk and opportunities of the organisation under the system
- Integration and cooperation of compliances with legal and other relevant systems.

Furthermore, the organisation shall pursue an assurance internally and other interested parties under the required approach, process and procedures, which classified as an effective OHSMS in the organisation. In addition, the PDCA cycle has been integrated in this system and its elements are visualised below as,

- Plan is to predict and assess risk, opportunities and objective of the system and its processes that rely on result of the tasks and management by the policy of the organisation under the operation of the system.
- Do is to comply to what has been planned wisely with alternatives.
- Check is to monitor and measure activities and processes regarding to OHSMS policy and objective within reporting appropriate issues or results after the approach has been accomplished.
- Act is to take an action purposely on continual improvement of OHSMS performance to achieve the intended outcomes.



The concept is cooperating with the system, which relationship between it can be illustrated below (Figure 4.4) as,

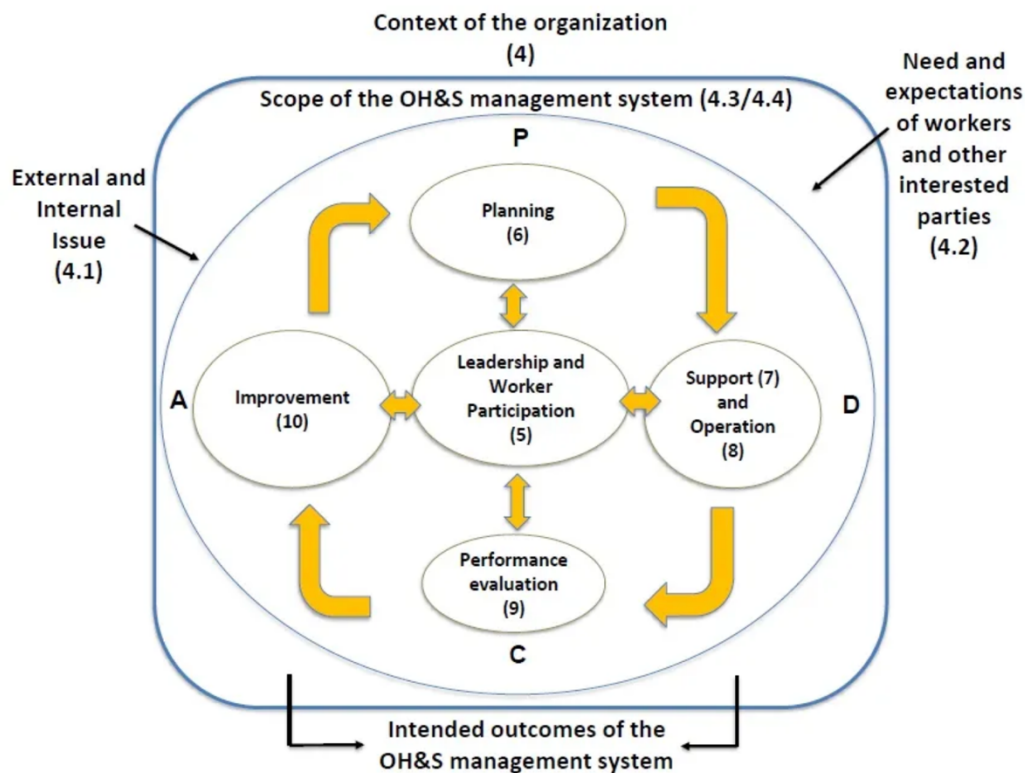


Figure 4.3 PDCA module of the standard (The number in the bracket referred to the clauses of the standard)

(TQP, 2022) There are several standards and systems under ISO that co-operate under the similar structure that form out of 10 clauses such as, ISO 9001 or QMS, ISO 45001 OHSMS, ISO 14001 or environmental safety and ISO 50001 or energy management system. For instance, [19] clauses of this standard are justified it in the same structure of ISO 9001:2015, which in annex A is explaining an informative context regarding on further requirements of the standard and clause 3 is mentioning terms and definitions in conceptual order.

#### 4.4.4 Integrated Safety Management System

(EUROLAB) Integrated Safety Management System Certification in business today is crucial regarding on reputation and competition in the market, which by opening to a new management, approach, process, method and technology developments may shine the interest towards the existing market. Nowadays they are various standards and systems that are published in order to form production and management wisely as a common structure. For instance, ISO 9001 Quality Management System, ISO 14001 Environmental Management System, ISO 27001 Information Security Management System, ISO 22000 Food Safety Management System, AS 9110 Quality Management System for Aviation and Space Industry, HACCP Hazard Analysis and Critical Control Points System and other relevant systems that

the carrier is adapting to the organisation. Moreover, standard structure of each system is unique within different requirements and by utilising all systems in the enterprise may contribute deficiencies and incorrect application towards the organisation. For this reason, integrated management system has been developed and distributed as a structure where management systems are gathered under one roof within diversified enforcements that are met together. An integration management system is various systems that are audited together at the same time and documented appropriately. By this method, the organisation can save time instead of inspecting it individually, while auditing is producing its process. Since, the common processes of the systems are pursuing in the same procedure. Nevertheless, competitive environment in the industries are dramatically high, which only stay ahead is not enough. Therefore, in order to sustain the asset and equity of the organisation within operation under standards and regulations, which integrated system is mainly combine scope of quality, healthy, safety, and environment that leads the organisation to produce more efficiency, high performance and high quality of products or services.

In term of aviation maintenance organisation, it is primarily to comply SMS, QMS, SAS or aviation Safety system And labour health protection System, which supplies the organisation to follow the regulatory requirement. Enterprise Resources Planning or ERP becoming a strategy that accountable to managerial in sphere of finances, human resources, assets, collaboration of partner and recording of operation history towards customer, which it is reasonable to allocate resources between safety and production development. Furthermore, Customer Relationship Management system or CRM use to manage mutual relationship with customer to optimise business process, which the key component is special software to process the approach as managing work, monitor customer actions and communication automation. Therefore, partner and customer of aircraft maintenance organisation are aircraft operators, which essentially concerns or flight safety.

For instance, (PCAA) ISO 45001 is a standard for occupational health and safety management system that adopted by organisations globally , which aim to control and improve health and safety performance in the organisations as to emphasise their employees safety and protection towards their operation by using Occupational Health and Safety Management Systems or OHSMS, which consisted of,

- OHS management system requirements
- Implementation and operation
- Documentation
- Checking
- Evaluation of compliance
- Incident investigation, nonconformity, corrective action and preventive action
- Management review.

In addition, (Roelen & Klompstra, 2012) the integration between Safety Management System (SMS) and Occupational safety Health and Safety Management System (OHSMS) are focusing on,

- Operation safety and hazards assessment that are identified in an SMS in term of contribution or likelihood to a catastrophic accident.
- Health of safety of operation in working environment such as, risk of various type in term of physical injury as slips, falls, truck-by incident, physical strain, electrocution and vehicle incidents.

By sharing information between those systems leads to safer working environment from employer to operation procedures. On the other hand, in case of conflict that may exist between requirements by various regulations and internal maintenance of management system in the organisation. For instant, the focus of quality should not interfere values of safety and fundamental aspect of the SMS, which shall not be lost. In addition, proposed amendments or changes in the management systems are able to be determined in order to adopt, adapt or reject.

(SMS Pro) A pure integrated safety management system is a cooperation of all aviation safety systems under the group within business process into one complete framework that allows aviation service providers work through single unit. In addition, ISMS allows the organisation to access one data that integrated into one unit seamlessly, instead of access through each division or department that having their own safety management system, which in this case all department in the same group under the organisation can access through SMS in the entire group appropriately. ISMS is based on security, which limiting user to reach to delicate and confidential depends on their job description within restricted the duplication, which become easier to manage among diversified functions through the organisation. In addition, it helps management teams to struct a system efficiency and effectiveness in order to deliver organisation safety objectives. For instance, to manage employee safety needs, to monitoring customer complaints, encouraging best practice to minimising risk and maximising safety resources.

(Aseev & Sharov, 2021) The concept of integrated system has been existed for a period of time since 2007 in the International Air Transport Association or IATA that introduced IAMS or Integrated Airline Management System and ISMS or Integrated Safety Management System for aviation organisation. In addition, by ICAO ISMS development is targeting flight safety and quality in aircraft maintenance organisation within the goals of,

- To reduce the number of all types aviation event throughout personnel fault by 50% at least, when compare with its previous year index.
- To reduce the number of irregularities while performing maintenance and repair by 20% at least, when compare with its previous year index.

- To reduce the number of claims from customers by 15%, compare from its previous year index.
- To reduce the number of detected conflicts or discrepancies of external audit by 10%, compared with its previous year index.
- To monitor ISMS effectiveness in term of auditing and monthly control of indexes as well as risk assessment and implementation of safety guarantees program.
- To guarantee conformance of the organisation activities or operations towards domestical, regional and international standards in terms of flight safety, which considered as safety guaranteed.
- To cultivate safety culture with development of voluntary report.

Furthermore, this is the core of ISMS, which additional may be added, depends on constituents and the organisation indexes are relevant to Safety Performance Indicator or SPI that involved SMART principles as Specific, Measurable, Achievable, Relevant and Time bound. As the result of that, particular, measurable, achievable, reliable and time bound are the required implementation in ICAO ISMS conceptual framework of Flight Safety Guarantee or confirmation of flight safety.

#### **4.4.5 Integrated Quality Safety Management System**

(Aseev & Sharov, 2021) Modern aviation service provider are loads of risk-related associated with their activity, which it is undeniable to justified that SMS and QMS are synchronised to aeronautic maintenance organisation nowadays. However, there are difficulties to imply the systems with comprehension towards the integration of both system to manage and analyse to fulfil changes within satisfying production operation in the maintenance organisation, which results as ISMS or integrated safety management system that concerns of aircraft maintenance organisation that integrate management of flight safety, quality, aviation information and environment safety, which encounters to data redundancy or duplication of hazard factors manifest in various aspects in the operations. Furthermore, it is difficult to collect and process corrective and preventive measures, but it can be solved by using factor analysis principle components, which providing an expert supplementary and scientific data to qualify operation activities that based on data of the organisation purposing for optimising hazard factors in operation activity.

(Roelen & Klompstra, 2012) QMS and SMS are compatible to be integrated, which help fulfilling carrier quality and safety gaps that satisfy customer and the organisation themselves, which both systems are form of similar elements such as,

- Policy
- Objective

- Management commitment
- Training
- Education
- Communication towards the organisation.

Even though, objective and aims of both systems are different but by similarity of the element that organisation have to implement both systems and tools in order to ensure continuously improvement as well as assessing internal evaluation, internal and external audits. Therefore, an integration between safety and quality systems are formed by an exchange of information between quality and safety management together with solving conflict between both related matters and aspect of each systems. On the other hand, an essential attention and comprehension between both systems is the component of safety risk management or SRM under SMS that consist of reactive, proactive and predictive approaches to hazard identification, risk assessment and mitigation. Safety risk expressing the term of predicted probability and severity of consequences from the hazard, which referred to worst case scenario. In addition, SMS investigation is focusing on safety hazard and all contributed factors that might lead to an accident or incident while, QMS does not required hazard identification, investigation nor relevant approach that SMS required beside customer satisfaction from production to final product, which SMS fulfilling the gaps of safety satisfaction in the organisation.

## Chapter 5

### Case study

#### 5.1 Case study of ISO 9001 in Air Maintenance Organisation

This section illustrating quality modules of air maintenance organisation that operation under ISO 9001 and AS 9110, Part 145 and Safety management system.

##### 5.1.1 Comparison and Illustration of ISO 9001:2015 and (CAAM) Part 145 Modules

(Abdullah, 2022) In order to comprehend the reason that the organisation has been adopted and maintained various standards and systems, the case and examples shall be provided. Based by Abdullah A. H. H. has been provided an example between CAAM Part 145 approval of Malaysia and ISO 9001:2015 QMS that an organisation intended to maintain aircraft, aircraft engines and parts must comply with regulatory of CAAM in the CAD 8601 – Maintenance Organisation Approval or CAAM Part 145 to ensure that the services or products launched are safe to use as well as maintenance activities are following the OEM manuals. On the other hand, there are lack of clear definitions in CAAM Part 145, beside mentioning it 9 times nor answering “What is quality system?”. For instance, below are certain part of CAAM Part 145 manual that does not justified the meaning of quality, which illustrated below (Table 5.1 – 5.2 – 5.3) as,

#### Quality System in CAD 8601 - Maintenance Organisation Approval (CAAM Part 145)

Quality System	Appears 9 time in the CAD
1	5.12 SAFETY AND QUALITY POLICY, MAINTENANCE PROCEDURES AND <b>QUALITY SYSTEM</b> (145.65)
2	5.2 Personnel requirements (145.30) c) The accountable manager under paragraph 5.2 a) of this Directive shall nominate a person, with responsibility for <b>monitoring the quality system</b> , including the associated feedback system as required by paragraph 5.12 c) of this Directive.
3	5.3 Certifying staff (145.35) j) The <b>person responsible for the quality system</b> shall also remain responsible on behalf of the organisation for issuing certification authorisation to certifying staff. Such person may nominate other persons to actually issue or revoke the certification authorisation in accordance with a procedure as specified in the exposition.

Table 5.1 Quality System in CAD 8601 – Maintenance Organisation Approval (CAAM Part 145) 01

4,5,6	<p><b>5.12 Safety and quality policy, maintenance procedures and quality system (145.65)</b></p> <p>c) The organisation shall establish a <b>quality system</b> that includes the following—</p> <p>1) Independent audits in order to monitor:</p> <p>i) compliance with required aircraft / aircraft component standards; and</p> <p>ii) adequacy of the procedures to ensure:</p> <p>I) that such procedures invoke good maintenance practices; and</p> <p>II) airworthy aircraft / aircraft components.</p> <p>In small organisations, the independent audit part of the <b>quality system</b> may be contracted to another organisation approved under this Directive or a person with appropriate technical knowledge and proven satisfactory audit experience.</p> <p>2) A quality feedback reporting system to the person or group of persons specified in paragraph 5.2 b) of this Directive and ultimately to the accountable manager that ensures proper and timely corrective action is taken in response to reports resulting from the independent audits established to meet paragraph 5.12 c) 1) of this Directive.</p>
7	<p><b>5.13 Maintenance organisation exposition (145.70)</b></p> <p>a) The organisation shall provide CAAM with a maintenance organisation exposition, containing the following information:</p> <p>12) the procedures and <b>quality system</b> established by the organisation under paragraphs 5.1 to 7.2 of this Directive and any additional procedure followed in accordance with CAD 6801; CAD 6801 - Continuing Airworthiness of Aircraft (CAAM Part M) ISS01/REV01</p>

Table 5.2 Quality System in CAD 8601 – Maintenance Organisation Approval (CAAM Part 145) 02

8	<p><b>Privileges of the organisation (145.75)</b></p> <p>6.1 Privileges of the organisation (145.75) In accordance with the exposition, the organisation who holds certificate of approval shall be entitled to carry out the following tasks—</p> <p>b) Arrange for maintenance of any aircraft or component for which it is approved at another organisation that is working under the <b>quality system</b> of the organisation. This refers to work being carried out by an organisation not itself appropriately approved to carry out such maintenance under this Directive and is limited to the work scope permitted under procedures laid down in paragraph 5.12 b) of this Directive. This work scope shall not include a base maintenance check of an aircraft or a complete workshop maintenance check or overhaul of an engine or engine module;</p>
9	<p><b>1.6 Records</b></p> <p>The <b>quality system</b> shall review and archive in an exhaustive manner the relevant files resulting from the implementation of this procedure.</p>

Table 5.3 Quality System in CAD 8601 – Maintenance Organisation Approval (CAAM Part 145) 03

As ISO 9001 is an international standard that specified requirements for QMS, which demonstrated an ability to provide consistencies of products or services launched under customer focus within other legal requirements. There are AS 9110, which highlight requirements for Aviation Maintenance Organisation regarding aviation maintenance. Moreover, CAAM has published legislation approved as a document CAD 8601 or CAAM Part 145, which enforce the organisation to develop and operate with ISO 9001 and AS 9110, which considered as quality standards that aimed to produce a products that are safe to use.

From seeing each other standards corrects loop holes for each other as much as possible. For example, certain part of one standard may fulfil another standard that does not contain a clear context. In addition, in clauses 1 to 3 or introduction of CAAM Part 145 does not contain elements such ISO contained as 0.3.2 or PDCA cycle and 0.3.3 Risk-based thinking, which it fulfilling the missing gaps that necessary to be in the standard that can be seen below (Table 5.4) as,

ISO9001:2015	Part 145 / CAD CAD 8601 - Maintenance Organisation Approval (CAAM Part 145)
<b>Introduction</b>	
0.1 General	
0.2 Quality management principles	
0.3 Process approach	
0.3.1 General	
0.3.2 Plan-Do-Check-Act cycle	
0.3.3 Risk-based thinking	
0.4 Relationship with other management standards	
1 Scope	
2 Normative references	
3 Terms and definitions	

Good elements no in the Part 145  
0.3.2  
0.3.3

Table 5.4 ISO 9001:2015 VS CAAM Part 145 01

Beside the missing parts that ISO fulfilling the gaps, which are the standard of ISO. There are risk-based thinking philosophy that is a part of ICAO Chicago Convention Annex 19 SMS as well as activities related to the aircraft, engine or aircraft parts and components. In addition, ISMS or SMS that integrate other management systems in the frame as finances, human capital, documents and any other relevant systems. Nevertheless, the element of the organisation and its context is a missing element, where it needs to be determined internally and externally regarding on customer satisfaction and quality of the products and services within lists of opinion between interested external parties to the organisation regarding on scope of the quality management system, which illustrated below (Table 5.5 – 5.6) as,

4 Context of the organization	N/A
4.1 Understanding the organization and its context	N/A
4.2 Understanding the needs and expectations of interested parties	<p>145.A.15 Application</p> <p>145.A.30 Personnel requirements</p> <p>145.A.42 Components</p> <p>145.A.45 Maintenance data</p> <p>145.A.60 Occurrence reporting</p> <p>145.A.65 Safety and quality policy, maintenance procedures and quality system</p> <p>145.A.70 Maintenance organisation exposition</p> <p>145.A.75 Privileges of the organisation</p> <p>145.A.80 Limitations on the organisation</p> <p>145.A.85 Changes to the organisation</p> <p>145.A.90 Continued validity</p> <p>145.A.95 Findings</p>
4.3 Determining the scope of the quality management system	<p>145.A.20 Terms of approval</p> <p>145.A.70 Maintenance organisation exposition</p> <p>145.A.75 Privileges of the organisation</p> <p>145.A.80 Limitations on the organisation</p> <p>145.A.85 Changes to the organisation</p> <p>145.A.90 Continued validity</p>
4.4 Quality management system and its processes	

Very important elements

Table 5.5 ISO 9001:2015 VS CAAM Part 145 02



4.4 Quality management system and its processes	
4.4.1 .. Establish, implement, maintain and continually improve ..	145.A.47 Production planning 145.A.60 Occurrence reporting 145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition 145.A.90 Continued validity
4.4.2 .. Maintain documented information ..	145.A.20 Terms of approval 145.A.30 Personnel requirements 145.A.35 Certifying staff and support staff 145.A.36 Records of airworthiness review staff 145.A.42 Components 145.A.45 Maintenance data 145.A.48 Performance of maintenance 145.A.55 Maintenance and airworthiness review records 145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition 145.A.90 Continued validity

Table 5.6 ISO 9001:2015 VS CAAM Part 145 03

On the other hand, the comprehension of organisational context is missing, which by ISO assistance, the expression externally supports reliability that leads the organisation into a realistic path of the management and movement under the adoption and circulation of the system. As well as customer focus that is missing, which the enterprise is focusing on components and compliances to maintain an aircraft that concerns on OEM or Original Equipment Manufacturer. Once the tasks has been completed, the organisation may issue Form 01 to declare airworthiness of the parts and components and has been fixed. However, some carrier does not concerns on the competitors since they are business without or having less competitors given them rarely to adapt on changes but in reality, this topic may be emphasised to make a movement when it necessary.

Even though, ISO has been fulfilling the missing gaps of Part 145 in customer satisfaction, which is the crucial missing gaps of each other that reveal as an acceptable outcome on perspective of relevant areas and in charged in the aviation industry. For instance, ISO 9001:2015 clause 5 guide the organisation to path customer focus in the strategy, which below (Table 5.7) is a missing gap that ISO pursuing assistances to minimise gaps of operation seamlessly as,

ISO9001:2015	Part 145 / CAD CAD 8601 - Maintenance Organisation Approval (CAAM Part 145)
5.1.1 General	145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.90 Continued validity 145.A.95 Findings
5.1.2 Customer focus	N/A
5.2 Policy	
5.2.1 Establishing the quality policy	145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition
5.2.2 Communicating the quality policy	145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition
	145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition

Table 5.7 ISO 9001:2015 VS CAAM Part 145 04

Element 6 of the standard is on planning of risks and opportunities, which are the part of Chicago convention Annex 19 SMS in the Air Maintenance Organisation that adopted ISO standard has been concreting the missing part to pursue an uplift of the system in the industry and released below (Table 5.8) as,

6 Planning	
6.1 Actions to address risks and opportunities	← Important elements missing
6.1.1 .. Consider issues of 4.1 and requirements of 4.2 ..	
6.1.2 .. Actions to address risks and opportunities	
6.2 Quality objectives and planning to achieve them 6.2 Quality objectives and planning to achieve them	
6.2.1 .. Quality objectives at relevant functions ..	
6.2.2 .. Determine what, who, when, how ..	
6.3 Planning of changes	145.A.70 Maintenance organisation exposition 145.A.85 Changes to the organisation

Table 5.8 ISO 9001:2015 VS CAAM Part 145 05

However, Part 145 of CAAM is missing monitoring and measuring resources, which ISO fulfilling it as a figure (Table 5.9) below as,

7 Support	
7.1 Resources	
7.1.1 General	145.A.30 Personnel requirements 145.A.40 Equipment and tools 145.A.47 Production planning 145.A.70 Maintenance organisation exposition 145.A.80 Limitations on the organisation
7.1.2 People	145.A.30 Personnel requirements 145.A.35 Certifying staff and support staff 145.A.70 Maintenance organisation exposition
7.1.3 Infrastructure	145.A.25 Facility requirements 145.A.42 Components
7.1.4 Environment for the operation of processes	145.A.25 Facility requirements 145.A.47 Production planning 145.A.60 Occurrence reporting
7.1.5 Monitoring and measuring resources	It is in Part 145 but most of the time lost its context
7.1.5.1 General	
7.1.5.2 Measurement traceability	

Table 5.9 ISO 9001:2015 VS CAAM Part 145 06

7.1.5 of ISO 9001:2015 supporting Part 145 of CAAM in the section of monitoring with processes and requirements of Man-hour planning in CAD 8601 or CAAM Part 145 – Maintenance Organisation Approval.

7.1.6 Organizational knowledge	Some companies takes this lightly
7.2 Competence	
7.3 Awareness	145.A.30 Personnel requirements
7.4 Communication	145.A.15 Application 145.A.30 Personnel requirements 145.A.45 Maintenance data 145.A.50 Certification of maintenance 145.A.55 Maintenance and airworthiness review records 145.A.60 Occurrence reporting 145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition 145.A.85 Changes to the organisation 145.A.90 Continued validity 145.A.95 Findings

Table 5.10 ISO 9001:2015 VS CAAM Part 145 07

As well as organisation knowledge illustrated above (Table 5.10) that does not being justified in Part 145, which by the emphasise of ISO leads the carrier to maintain their organisation knowledge inside out from practices and cultures of employees from sustain policies.

Nevertheless, on element 8 of the standard in comparison, can be seen that Part 145 is dealing with tasks and activities regarding to the job within data base, platform and documentation, while ISO 9001 standard is prioritising and emphasising towards the products or service of the organisation to follow its restrictions and controlled progress as to ensure that it matches customer expectations, satisfactions, trends of user and the ability of the enterprise to operate the system in their environment. Moreover, figures below (Table 5.11) as,

<b>8 Operation</b>	
8.1 Operational planning and control	145.A.30 Personnel requirements 145.A.42 Components 145.A.45 Maintenance data 145.A.47 Production planning 145.A.75 Privileges of the organisation
	145.A.42 Components 145.A.50 Certification of maintenance 145.A.60 Occurrence reporting
	145.A.42 Components
8.2 Requirements for products and services	
8.2.1 Customer communication	145.A.50 Certification of maintenance 145.A.65 Safety and quality policy, maintenance procedures and quality system
8.2.2 Determining the requirements for products and services	145.A.45 Maintenance data 145.A.65 Safety and quality policy, maintenance procedures and quality system
8.2.3 Review of the requirements for products and services	
8.2.3.1 .. Ensure ability to meet requirements ..	145.A.50 Certification of maintenance 145.A.65 Safety and quality policy, maintenance procedures and quality system
8.2.3.2 .. Retain documented information ..	
8.2.4 Changes to requirements for products and services	145.A.45 Maintenance data
8.3 Design and development of products and services	
8.3.1 General	145.A.75 Privileges of the organisation
8.3.2 Design and development planning	
8.3.3 Design and development inputs	
8.3.4 Design and development controls	
8.3.5 Design and development outputs	145.A.42 Components
8.3.6 Design and development changes	

Table 5.11 ISO 9001:2015 VS CAAM Part 145 08

In addition, below (Table 5.12) is another half of clause 8 in the module, which mainly identifying topic of operation, which ISO standard is focusing on design, control, preservation and an extension of the product or service towards inputs and outputs of the organisation as well as after delivery activities to ensure that product or service are safe to use as a quality of safety. On the other hand, Part 145 of CAAM is mainly on processes, procedures, data base and report system that assisting the operation by the comprehension of performing tasks with relevant tools and equipment.

8.4 Control of externally provided processes, products and services	
8.4.1 General	145.A.42 Components 145.A.70 Maintenance organisation exposition 145.A.75 Privileges of the organisation
	145.A.42 Components 145.A.70 Maintenance organisation exposition 145.A.75 Privileges of the organisation
8.4.2 Type and extent of control	145.A.42 Components 145.A.75 Privileges of the organisation
8.4.3 Information for external providers	145.A.42 Components 145.A.75 Privileges of the organisation
8.5 Production and service provision	
8.5.1 Control of production and service provision	145.A.25 Facility requirements 145.A.30 Personnel requirements 145.A.42 Components 145.A.45 Maintenance data 145.A.47 Production planning 145.A.48 Performance of maintenance 145.A.55 Maintenance and airworthiness review records 145.A.75 Privileges of the organisation
	145.A.40 Equipment and tools
	145.A.30 Personnel requirements
8.5.2 Identification and traceability	145.A.42 Components 145.A.50 Certification of maintenance 145.A.55 Maintenance and airworthiness review records
8.5.3 Property belonging to customers or external providers	145.A.45 Maintenance data
8.5.4 Preservation	145.A.25 Facility requirements 145.A.42 Components
8.5.5 Post-delivery activities	145.A.60 Occurrence reporting
8.5.6 Control of changes	145.A.85 Changes to the organisation
8.6 Release of products and services	145.A.50 Certification of maintenance 145.A.55 Maintenance and airworthiness review records 145.A.75 Privileges of the organisation
8.7 Control of nonconforming outputs	145.A.42 Components 145.A.60 Occurrence reporting
	145.A.42 Components 145.A.60 Occurrence reporting

Table 5.12 ISO 9001:2015 VS CAAM Part 145 09

On the other hand, element 9 of Part 145 has been missing customer satisfaction sector, which it is crucial towards movement in the industry or their own market together with management review that it is limited towards limitation of regulatory compliances by platform and procedures that being restricted. Which by the integration and transaction of each other standards in the enterprise that minimising the gaps or loop holes of the system used under various standards from management to performing tasks and it can be seen it by the figure (Table 5.13) below as,

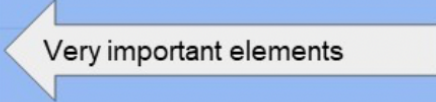
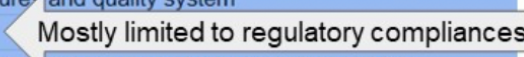
ISO9001:2015	Part 145 / CAD CAD 8601 - Maintenance Organisation Approval (CAAM Part 145)
<b>9 Performance evaluation</b>	
9.1 Monitoring measurement, analysis and evaluation	
9.1.1 General	145.A.48 Performance of maintenance 145.A.60 Occurrence reporting
9.1.2 Customer satisfaction	 Very important elements
9.1.3 Analysis and evaluation	145.A.48 Performance of maintenance 145.A.60 Occurrence reporting
9.2 Internal audit	
9.2.1 .. Conduct internal audits at planned intervals ..	145.A.65 Safety and quality policy, maintenance procedures and quality system
9.2.2 .. Plan, establish, implement and maintain audit program ..	145.A.65 Safety and quality policy, maintenance procedures and quality system
9.3 Management review	 Mostly limited to regulatory compliances
9.3.1 General	145.A.65 Safety and quality policy, maintenance procedures and quality system
9.3.2 Management review inputs	145.A.65 Safety and quality policy, maintenance procedures and quality system
9.3.3 Management review outputs	145.A.65 Safety and quality policy, maintenance procedures and quality system

Table 5.13 ISO 9001:2015 VS CAAM Part 145 10

Moreover, clause 10 of ISO 9001:2015 is form of non-conformity actions correctively or preventively to pursue continual improvement by assessing actions towards the occurrence, which Part 145 of CAAM is assisting this case by providing reports to allocate and acknowledge the circumstance before suitable actions has been taken. As can be seen, by the integration and operation of the standard, approval and system not only minimising missing gaps between the systems in the organisation that aimed to create mobility towards the market and the industry but to keep improving by keep searching or investigating the operation to prevent risks, hazard and unlawful acts in the carrier with the assistance of the data base, template and procedures of the systems that cooperate in the operation and management, which the module can be seen below (Table 5.14) as,

10 Improvement		
10.1 General	145.A.60 Occurrence reporting 145.A.95 Findings	Improve products, services, and QMS; address future needs
10.2 Nonconformity and corrective action		
10.2.1 Nonconformity and Corrective Action	145.A.60 Occurrence reporting 145.A.95 Findings	Correct, eliminate causes; review effectiveness; update risks; flow down; documented process
10.2.2 Nonconformity and Corrective Action	145.A.60 Occurrence reporting 145.A.95 Findings	Evidence of nonconformities; actions taken; results
10.3 Continual improvement		Improve suitability, adequacy, and effectiveness of system; monitor implementation; evaluate effectiveness

Table 5.14 ISO 9001:2015 VS CAAM Part 145 11

In order to reach to a better view by comparing between AS 9110C, which is a supplementary for ISO 9001:2015 standard in aeronautic maintenance organisation or AMO that specifically made for quality management system. In addition, the standard is covering requirements that specified in civil and military aviation maintenance and continuing airworthiness such as requirements, definitions and notes, which are complementary to customers and applicable regulatory requirements.

### 5.1.2 Comparison and Illustration of AS 9110c and CAAM Part 145 Modules

Nevertheless, (Abdullah, 2022) clause 1 to 3 of AS standard that illustrated below (Table 5.15) is the introduction part, where it mentioning the general terms and vocabulary, descriptions of the standard, PDCA cycle, risk-based thinking, scope that the organisation shall obtain and relationship of the standard towards the integration in other systems and sub-systems in the carrier. However, tools and other objectives that convince a smoothness of the operation under the standards, which Part 145 of CAAM does not being provided since it is an introduction and description before the structure has been introduced. In addition, clause 0.3.2 is a PDCA cycle, which operated under the provisioning of ISO QMS platform that leads to continuously improvement. Risk based thinking philosophy or clause 0.3.3 has been integrated with CAD 19 – Safety Management System (SM) ISS02/REV00 as Annex 19 Chicago Convention footprint in the path of integrated safety management system or ISMS, which covering aircraft maintenance activities, parts, components and engines as well as finances, humans capital, documents and other sub-systems that circulated in the organisation.



AS9110C	Part 145 / CAD 8601 - Maintenance Organisation Approval (CAAM Part 145)	Remarks
<b>Introduction</b>		
0.1 General		
0.2 Quality management principles		
0.3 Process approach		
0.3.1 General		
0.3.2 Plan-Do-Check-Act cycle 		
0.3.3 Risk-based thinking 		CAD 19 - Safety Management (SM) ISS02/REV00
0.4 Relationship with other management standards		
1 Scope		
2 Normative references		
3 Terms and definitions		

Table 5.15 AS9110C VS CAAM Part 145 01



On the other hand, element 4 that illustrated below (Table 5.16) of the AS standard leads follower or all positions in the carrier to comprehend and realise contexts and processes of quality management system within anticipation of interested parties. In addition, tools and data base that required to process clause 4 of AS standard has been provided by the organisation, since this is the part where company determined its internal and external issues that affect customer satisfaction, efficiency and effectively of product and service launch as well as other relevant parties opinion and scope of the quality management system.


4 Context of the organization	N/A	
4.1 Understanding the organization and its context 	N/A	Internal / external issues; strategic direction; intended results
4.2 Understanding the needs and expectations of interested parties	145.A.15 Application 145.A.30 Personnel requirements 145.A.42 Components 145.A.45 Maintenance data 145.A.60 Occurrence reporting 145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition 145.A.75 Privileges of the organisation 145.A.80 Limitations on the organisation 145.A.85 Changes to the organisation 145.A.90 Continued validity 145.A.95 Findings	Relevant interested parties; their relevant requirements
4.4 Quality management system and its processes		
4.4.1 Quality Management and its Processes	145.A.47 Production planning 145.A.60 Occurrence reporting 145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition 145.A.90 Continued validity	Needed processes, their interactions, their application; customer and legal requirements for QMS
4.4.2 Quality Management and its Processes	145.A.20 Terms of approval 145.A.30 Personnel requirements 145.A.35 Certifying staff and support staff 145.A.36 Records of airworthiness review staff 145.A.42 Components 145.A.45 Maintenance data 145.A.48 Performance of maintenance 145.A.55 Maintenance and airworthiness review records 145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition  145.A.90 Continued validity	Support for process operation; evidence for confidence; list of required documented information

Table 5.16 AS9110c VS CAAM Part 145 02

AS9110C	Part 145 / CAD CAD 8601 - Maintenance Organisation Approval (CAAM Part 145)	Remarks
<b>5 Leadership</b>		
<b>5.1 Leadership and commitment</b>		
5.1.1 General	145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.90 Continued validity 145.A.95 Findings	Accountability; demonstrated leadership and commitment; Safety policy; safety objectives; audit corrective actions
5.1.2 Customer focus	N/A	Requirements; risks addressed; customer satisfaction; Measurement of conformity and on-time delivery performance / CAD 19 - Safety Management (SM) ISS02/REV00
<b>5.2 Policy</b>		
5.2.1 Establishing the quality policy	145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition	Requirements; risks addressed; customer satisfaction; Measurement of conformity and on-time delivery performance / CAD 19 - Safety Management (SM) ISS02/REV00
5.2.2 Communicating the quality policy	145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition	Documented policy; communicated; understood; available
5.2.3 Understanding and Communicating the Safety Policy	145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition	Framework for safety objectives; safety reporting; continual improvement of safety management / CAD 19 - Safety Management (SM) ISS02/REV00
<b>5.3 Organizational roles, responsibilities and authorities</b>		
5.3.1 Accountable Manager	145.A.30 Personnel requirements 145.A.70 Maintenance organisation exposition 145.A.85 Changes to the organisation	Top executive with responsibility for scope of approval; ensures financing and that activities carried out to AS9110
5.3.2 Quality Manager	145.A.30 Personnel requirements 145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition 145.A.85 Changes to the organisation	Responsible for monitoring QMS; independent audit program; Ensures "accountable manager" informed on quality matters
5.3.3 Other Appointed Manager(s)	145.A.30 Personnel requirements 145.A.70 Maintenance organisation exposition 145.A.85 Changes to the organisation	Responsible for assuring operational activities carried out; ultimately responsible to "accountable manage

Table 5.17 AS9110C VS CAAM Part 145 03

Element 5 of AS standard (Table 5.17) is focusing on leadership, which this clause could be the great explanation towards integration of systems and standards in the enterprise. On the other hand, context of leadership has been guided by AS standard and Part 145 provide platform, documentation, guidance, records and requirements. For instance, 5.2.2 of AS9110C or QMS by AS standard revealing context of communicating quality policy on how to pursue the procedure, which Part 145 predicting document platform or templates that utilising in the carrier. On the other hand, in 5.1.2 has been under the path of CAD 19 – Safety Management System (SM) ISS02/REV00 as requirements, risks addressed, customer satisfaction under the measurement of effective delivery performance. As the focus of the organisation towards delivering on-time within quality, the carrier has been only issuing Form 1 to comply to airworthy after the service has been done within inspection, since it has been satisfied by the customer.

Furthermore, element 6 under AS standard can be seen as it is mainly describe on planning towards risks and opportunities of actions, quality objectives and movement towards changes, which Part 145 of CAAM providing MOE or Maintenance Organisation Exposition and documentation of changes into organisation. On the other hand, the element support the organisation to predict and to prepare of movements in the industry, which the module of the standard and approval can be seen below (Table 5.18) as,

6 Planning		
6.1 Actions to address risks and opportunities		
6.1.1 Actions to Address Risks and Opportunities		Issues (4.1); requirements (4.2); risks determined
6.1.2 Actions to Address Risks and Opportunities		Actions planned; integrated; implemented; evaluated
6.2 Quality objectives and planning to achieve them		
6.2.1 Quality Objectives and Planning to Achieve Them		Match policy; measurable; monitored; communicated
6.2.2 Quality Objectives and Planning to Achieve Them		What done; who does; when done; how evaluated
6.3 Planning of changes	145.A.70 Maintenance organisation exposition 145.A.85 Changes to the organisation	Purpose; consequences, resources; responsibilities

Table 5.18 AS9110C VS CAAM Part 145 04

Element 7 by AS standard is describing the topic of supportation of the organisation by the descriptions, suggestions and documented procedures to facilitate the requirements, ability, capability of the production under the determinations of collected data and evaluation of production performance towards all resources used. For instance, under this element has been controlled accessibility of documentation, records and data based by their position. However, it can be seen that element 7 leads the enterprise to be able to comprehend what, how and whom of the processes and knowledge of the activities with restricted qualification and licenses as well as knowledge to pursue an alternative or platform to accommodate when the result of production does not pass the verification. On the other hand, without element 7, it can provide lack of comprehension and restriction towards the context, responsibilities, processes and procedures of the job or performed tasks, which illustrated below (Table 5.19 and ) as,

AS9110C	Part 145 / CAD CAD 8601 - Maintenance Organisation Approval (CAAM Part 145)	Remarks
<b>7 Support</b>		
7.1 Resources		
7.1.1 General	145.A.30 Personnel requirements 145.A.40 Equipment and tools 145.A.47 Production planning 145.A.70 Maintenance organisation exposition 145.A.80 Limitations on the organisation	Resource capabilities; constraints; external needs; Available resources for safe, timely completion of activities
7.1.2 People	145.A.30 Personnel requirements 145.A.35 Certifying staff and support staff 145.A.70 Maintenance organisation exposition	People for implementation; operation; control
7.1.3 Infrastructure	145.A.25 Facility requirements 145.A.42 Components	Facilities; equipment; transportation; information technology; means to segregate articles and products
7.1.4 Environment for the operation of processes	145.A.25 Facility requirements 145.A.47 Production planning 145.A.60 Occurrence reporting	Social, psychological, and physical factors

Table 5.19 AS9110C VS CAAM Part 145 05

AS9110C	Part 145 / CAD CAD 8601 - Maintenance Organisation Approval (CAAM Part 145)	Remarks
<b>7 Support</b>		
7.1 Resources		
7.1.1 General	145.A.30 Personnel requirements 145.A.40 Equipment and tools 145.A.47 Production planning 145.A.70 Maintenance organisation exposition 145.A.80 Limitations on the organisation	Resource capabilities; constraints; external needs; Available resources for safe, timely completion of activities
7.1.2 People	145.A.30 Personnel requirements 145.A.35 Certifying staff and support staff 145.A.70 Maintenance organisation exposition	People for implementation; operation; control
7.1.3 Infrastructure	145.A.25 Facility requirements 145.A.42 Components	Facilities; equipment; transportation; information technology; means to segregate articles and products
7.1.4 Environment for the operation of processes	145.A.25 Facility requirements 145.A.47 Production planning 145.A.60 Occurrence reporting	Social, psychological, and physical factors
7.1.5 Monitoring and measuring resources		
7.1.5.1 General	145.A.40 Equipment and tools	Resources for valid, reliable monitoring and measuring results
7.1.5.2 Measurement Traceability	145.A.40 Equipment and tools	Calibration; verification; traceability to standards; recall; register of equipment; calibration in suitable environment
7.1.6 Organizational knowledge		Maintained; available; how to acquire, access, and update
7.2 Competence	145.A.30 Personnel requirements 145.A.35 Certifying staff and support staff 145.A.36 Records of airworthiness review staff 145.A.70 Maintenance organisation exposition	Education; training; experience; evidence of competence; Competency for airworthiness management and maintenance
7.3 Awareness	145.A.30 Personnel requirements	Policy; objectives; contributions; nonconformity implications; contributions; safety; ethical behavior; human factors
7.4 Communication	145.A.15 Application 145.A.30 Personnel requirements 145.A.45 Maintenance data 145.A.50 Certification of maintenance 145.A.55 Maintenance and airworthiness review records 145.A.60 Occurrence reporting 145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition 145.A.85 Changes to the organisation 145.A.90 Continued validity 145.A.95 Findings	On what; when; with whom; how; who communicates
7.5 Documented information		
7.5.1 General		Required by ISO 9001; determined by organization; necessary for effectiveness of product safety management
7.5.2 Creating and updating		Identification; description; format; media; approvals
7.5.3 Control of documented information		
7.5.3.1 Control of Documented Information	145.A.35 Certifying staff and support staff 145.A.45 Maintenance data 145.A.55 Maintenance and airworthiness review records	Available; suitable; protected from loss or improper use
7.5.3.2 Control of Documented Information	145.A.35 Certifying staff and support staff 145.A.36 Records of airworthiness review staff 145.A.45 Maintenance data 145.A.55 Maintenance and airworthiness review records 145.A.65 Safety and quality policy, maintenance procedures and quality system 145.A.70 Maintenance organisation exposition 145.A.90 Continued validity	Access; use; storage; version control; retention; disposition; obsolete documented information; data protection

Table 5.20 AS9110C VS CAAM Part 145 06

Element 8 of AS9110 within compatible objective of Part 145 of CAAM are assisting the operations in the organisation. Moreover, it is concerns from the start to the end of the production under the organisation within, requirements, acceptance, resources management and other relevant objectives and criteria that can be seen below (Table 5.21 – 5.22) as,

AS9110C	Part 145 / CAD CAD 8601 - Maintenance Organisation Approval (CAAM Part 145)	Remarks
<b>8 Operation</b>		
8.1 Operational planning and control	145.A.30 Personnel requirements 145.A.42 Components 145.A.45 Maintenance data 145.A.47 Production planning 145.A.75 Privileges of the organisation	Requirements; criteria; resources; controls; outsourcing; scheduled events in planned sequence
8.1.1 Operational Risk Management		Responsibilities; criteria; communication; actions; acceptance
8.1.2 Configuration Management	145.A.42 Components	Identify and control physical and functional attributes
8.1.3 Product Safety	145.A.50 Certification of maintenance 145.A.60 Occurrence reporting	Assure product safety during entire life cycle
8.1.4 Prevention of Counterfeit Parts		Plan, implement, control processes to prevent counterfeit use
8.1.5 Prevention of Suspected Unapproved Parts		Prevent use of unapproved and suspected unapproved parts
8.1.6 Installation of Approved Parts	145.A.42 Components	Identified; acceptable; satisfactory condition; dismantled
8.2 Requirements for products and services		
8.2.1 Customer communication	145.A.50 Certification of maintenance 145.A.65 Safety and quality policy, maintenance procedures and quality system	Information; inquiries; changes; complaints; property
8.2.2 Determining the requirements for products and services	145.A.45 Maintenance data 145.A.65 Safety and quality policy, maintenance procedures and quality system	Defined requirements; legal requirements; meet claims; determine special requirements; identify operational risks
8.2.3 Review of the requirements for products and services		
8.2.3.1 Review of the Requirements for Products and Services	145.A.50 Certification of maintenance 145.A.65 Safety and quality policy, maintenance procedures and quality system	Customer; organization; legal; differing from prior expressions; coordinated review; negotiation; technical data revision
8.2.3.2 Review of the Requirements for Products and Services		Records of review results; new requirements
8.2.4 Changes to requirements for products and services	145.A.45 Maintenance data	Amended documents; awareness of changes
8.3 Design and development of products and services		
8.3.1 General	145.A.75 Privileges of the organisation	Process established; implemented; maintained; aircraft and engine status; preparation of work order
8.3.2 Design and development planning		Stages; controls; activities; reviews; roles; resources
8.3.3 Design and development inputs		Functions; performance; legal requirements; standards; evaluation of continuing airworthiness requirements
8.3.4 Design and development controls		Results; reviews; verification; validation; actions; records; authorized stage progression; review participants
8.3.5 Design and development outputs	145.A.42 Components	Inputs met; adequate; acceptance criteria; safe provision; required data defined; outputs incorporated into work orders
8.3.6 Design and development changes		Identify, review; control; no adverse impacts; records; customer notification; changes per configuration management

Table 5.21 AS9110C VS CAAM Part 145 07

AS9110C	Part 145 / CAD CAD 8601 - Maintenance Organisation Approval (CAAM Part 145)	Remarks
8.4 Control of externally provided processes, products and services		
8.4.1 General	145.A.42 Components 145.A.70 Maintenance organisation exposition 145.A.75 Privileges of the organisation	Controls; evaluation; selection; monitoring; re-evaluation; customer-designated sources; risks of external providers
8.4.1.1 General	145.A.42 Components 145.A.70 Maintenance organisation exposition 145.A.75 Privileges of the organisation	Approval status; external provider register; periodic reviews; actions if nonconforming; flow down of safety principles
8.4.2 Type and extent of control	145.A.42 Components 145.A.75 Privileges of the organisation	Potential impact; effectiveness of controls; verification; performance review; approvals; certificates; risks identified
8.4.3 Information for external providers	145.A.42 Components 145.A.75 Privileges of the organisation	Approvals; interactions; controls; verification; validation; change notification; flow down; right of access
8.5 Production and service provision		
8.5.1 Control of production and service provision	145.A.25 Facility requirements 145.A.30 Personnel requirements 145.A.42 Components 145.A.45 Maintenance data 145.A.47 Production planning 145.A.48 Performance of maintenance 145.A.55 Maintenance and airworthiness review records 145.A.75 Privileges of the organisation	Characteristics; measurements; competencies; human error; verification points; foreign objects; work handover; utilities
8.5.1.1 Control of Equipment, Tools, and Software Programs	145.A.40 Equipment and tools	Controlled (calibrated); storage; periodic condition checks
8.5.1.2 Validation and Control of Special Processes	145.A.30 Personnel requirements	Approval criteria; facilities; qualification of persons; methods
8.5.1.3 Production Process Verification		
8.5.1.4 Evaluation of a New Capability		First article; capability list; first application of maintenance
8.5.2 Identification and traceability	145.A.42 Components 145.A.50 Certification of maintenance 145.A.55 Maintenance and airworthiness review records	Outputs; identification; status; traceability; actual vs. required configuration; acceptance authority media
8.5.3 Property belonging to customers or external providers	145.A.45 Maintenance data	Identify; verify; protect; safeguard; report if unsuitable
8.5.4 Preservation	145.A.25 Facility requirements 145.A.42 Components	Preserve outputs to ensure conformity to requirements; cleaning; foreign objects; labels; warnings; shelf-life; rotation
8.5.5 Post-delivery activities	145.A.60 Occurrence reporting	Potential undesired consequences; lifetime; feedback; product and customer support; problems after delivery
8.5.6 Control of changes	145.A.85 Changes to the organisation	Review and control changes; authorization; needed actions; approval of production or service provision changes
8.6 Release of products and services	145.A.50 Certification of maintenance 145.A.55 Maintenance and airworthiness review records 145.A.75 Privileges of the organisation	Verify requirements met; evidence of conformity; release documents; documented information for delivery
8.7 Control of nonconforming outputs		
8.7.1 Control of Nonconforming Outputs	145.A.42 Components 145.A.60 Occurrence reporting	Correction; containment; return; inform customer; concession; documented process; dispositions; counterfeit parts
8.7.2 Control of Nonconforming Outputs	145.A.42 Components 145.A.60 Occurrence reporting	Record of nonconformity; actions; concessions; authority

Table 5.22 AS9110C VS CAAM Part 145 08

Furthermore, the supplement standard is identifying acceptance criteria of information, restriction, limitation, approval and control of the product or service from input to output with verification to accept the result.

Element 9 of AS standard is focusing on monitoring, analysis, measurement and evaluation of internal and external audits as well as management and review of inputs and outputs. Therefore, by generation of tools and platforms to be used such as occurrence report, performance of maintenance analysis, safety and quality policies, maintenance procedures, and quality system becoming provided tools to perform the auditing and reviewing the purpose, method, action, follow-up case, objective and result before pursuing a movement on the result, which aimed to evaluate and explore the risks, failure and any circumstance that required an urgent management. On the other hand, the module between AS standard and Part 145 of CAAM is revealing below (Table 5.23) as,

AS9110C	Part 145 / CAD CAD 8601 - Maintenance Organisation Approval (CAAM Part 145)	Remarks
<b>9 Performance evaluation</b>		
9.1 Monitoring measurement, analysis and evaluation		
9.1.1 General	145.A.48 Performance of maintenance 145.A.60 Occurrence reporting	What done; methods; when measured; results; performance; evaluation of safety performance for products and services
9.1.2 Customer satisfaction		Perceptions; how obtained, monitored, and reviewed; delivery performance; complaints; corrective action requests
9.1.3 Analysis and evaluation	145.A.48 Performance of maintenance 145.A.60 Occurrence reporting	Conformity; performance; improvement needs; safety improvements; prevention of maintenance error
9.2 Internal audit		
9.2.1 Internal Audit	145.A.65 Safety and quality policy, maintenance procedures and quality system	Planned intervals; conformity to requirements; effectiveness
9.2.2 Internal Audit	145.A.65 Safety and quality policy, maintenance procedures and quality system	Audit frequency; methods; criteria; scope; results; actions
9.3 Management review		
9.3.1 General	145.A.65 Safety and quality policy, maintenance procedures and quality system	Action status; audits; issues; resources; performance; Changes to safety policy and safety objectives
9.3.2 Management review inputs	145.A.65 Safety and quality policy, maintenance procedures and quality system	Objectives; performance; actions; results; on-time delivery; product safety performance
9.3.3 Management review outputs	145.A.65 Safety and quality policy, maintenance procedures and quality system	Decisions; actions; improvements; evidence of results; risks

Table 5.23 AS9110C VS CAAM Part 145 09

However, there is a big subject in the clause that Part 145 does establishing criteria and objectives of customer satisfaction, which the mentioned topic is crucial and it is a goal of ISO system or it means that ISO 9001:2015 and AS9110 standard fulfil the missing gap by the explanations, terms and suggestions to pursue trend and demand of the customer, consumer and surrounded environment.

In element 10 of the standard, which visualised below (Table 5.24) is covering by 145.A.60 or occurrence reporting and 145.A.95 or findings that helps quality management systems that operates seamlessly by the assistance of Part 145 by providing tools for ISO 9001:2015 while it provides terms, description, guidance and recommendation towards the operation of the organisation. As an improvement by reviewing the nonconformity and corrective actions towards any circumstances of products and services to deliver continuous satisfaction to the customers. On the other hand, there is no specific restriction in Part 145 regarding on improvement but by utilising occurrence report and findings shall assisting operation of improvement in the organisation, which the occurrences require the organisation to report any major defects and findings on products and services. In addition, findings are used in order to records and correct nonconformity during audit and surveillance.

AS9110C	Part 145 / CAD CAD 8601 - Maintenance Organisation Approval (CAAM Part 145)	Remarks
<b>10 Improvement</b>		
10.1 General	145.A.60 Occurrence reporting 145.A.95 Findings	Improve products, services, and QMS; address future needs
10.2 Nonconformity and corrective action		
10.2.1 Nonconformity and Corrective Action	145.A.60 Occurrence reporting 145.A.95 Findings	Correct; eliminate causes; review effectiveness; update risks; flow down; documented process
10.2.2 Nonconformity and Corrective Action	145.A.60 Occurrence reporting 145.A.95 Findings	Evidence of nonconformities; actions taken; results
10.3 Continual improvement		Improve suitability, adequacy, and effectiveness of system; monitor implementation; evaluate effectiveness

Table 5.24 AS9110C VS CAAM Part 145 10

It provides a better vision towards comprehension by mapping ISO 9001 and AS 9110 that are complements towards Part 145 of CAAM or CAD 8601 – Maintenance Organisation Approval, which is useful towards customer satisfactions and uplift brand image of the organisation itself that sustain the organisation in the long run. Moreover, ISO and AS certificates are attracting customer externally, especially aircraft outside the approval states. For instance, FAA is only approve aircrafts under the U.S registration, which an approval of an organisation shall being approved by the authority where the organisation based. Since ICAO does not accept universal approval of aviation maintenance organisation or company that does not approved from the authority where the organisation belongs. Even though the states required to approve the carrier under the authority but ISO and AS may pursue the assurance towards the organisations that are acquiring the system compliance to any regulatory requirements.



## Chapter 6

### Conclusion

Safety and quality management systems in aeronautic maintenance organisation has been enforced under the framework of International Civil Aviation Organisation under United Nation that adopted by regional civil aviation safety agency in particular region that in charge of the adaption of the mentioned framework nationally via authority. For instance, ANAC is Civil Aviation national authority of Portugal that cooperate with EASA or European Union Aviation Safety Agency. Furthermore, the requirement of implementing, maintaining, improving and comprehending quality management system and safety management system within supplement certificates and standards as a sign of an improvement continuously together with sustainability towards management and operation as well as other relevant resources in the organisation. As the result of it, integration started to be demonstrated within technological platform within digitalisation of documentation, which it shall be possible to be integrated and especially it got its own characteristic that can be circulate in the organisation seamlessly that pursue the creation of Integrated Quality Safety Management System. It can be estimated that the enterprise that capable to obtain an update shall walking through migration as well as transactional period of migration between update from previous standards, certification and amendment. Which by gathering frameworks and requirements of the quality and safety management systems is one of the evidence that illustrate how safety management systems and quality management systems has been operated in the aeronautic maintenance organisation nowadays within the potential of further integration within improvement continuously towards the carrier or the enterprise. On the other hand, performance of each organisation is depending on capacity of adoption on the standards, certificates and other relevant approvals that are relying on performance of the whole carrier towards communication, comprehension and realisation of the organisation systems, culture, ethics, procedures and processes, which promotion of the mentioned criteria belongs to emphasis of each organisation to maintain it inside out.

As can be illustrated in the findings on chapter 5, approved maintenance organisation enforcing the carrier to adopt quality and safety that being integrated towards other relevant sub-systems in the means of ability and capability to deliver safe service efficiently and effectively. For instance (Abdullah, 2022) paragraph 5.12 or 145.65 in CAAM Part 145 has been justified as the organisation shall establish quality system within other relevant requirement and procedures under paragraph 5.1 to 7.2 of maintenance organisation exposition (145.70) or paragraph 5.13 in accordance with CAD 6801 or CAAM Part 145 as well as CAD 6801 in section continuing airworthiness of aircraft or CAAM Part M ISS01/REV01. In addition, in privileges of the organisation (145.75) has been justified that CAAM Part 145 is permit approved air maintenance organisation to arrange any maintenance towards any aircraft or component,

which it must be approved by another organisation under the carrier quality system. Therefore, in order to satisfy the operation, the organisation shall maintain quality continuously. ISO 9001:2015 and AS 9110c has been structuring its quality system in to 10 clauses, which safety and requirements of Part 145 has been integrated via procedures, documentations and information towards missing gaps that each systems are lack of. For example, CAAM Part 145 does not clearly define what the exact means of customer focus, which in this part organisation complying to requirement, risk assessment and measurement of on-time delivery performance towards safety manual of CAD 19 – Safety Management (SM) ISS02/REV00. As the result of it, once maintenance task has been completed towards the aircraft, the organisation release aircraft back to service and issue Form 01 to declared the fixing parts airworthy. Nevertheless, crucial element that does not revealed in approval maintenance organisation manual is risk-based thinking, which organisation comply to safety procedure and guidance towards its tasks, human capital, documentation and other relevant process. PDCA or Plan Do Check Act cycle has been the core of the organisation inside out that leads the carrier to be continuously improved, since Part 145 does not illustrated the guidance, quality management system has been demonstrated the guidance, requirement and other relevant terminology by the QMS process. As by the integration of systems internally persuade efficiency and effectiveness towards operation, which emphasising safety as a quality. By circulation of the system leads to comprehension of their own responsibility and involving in the organisation from quality structure and safety culture that pursuing safety and security towards the carrier. In term of management, quality and safety are crucial towards digitalisation of the paperwork, convenience to conduct and gather relevant information, enhance vision of management, uplift internal communication, increase brand image and value.

On the other hand, level of adoption and adaption of the approvals are based by the location and jurisdiction that the organisation located, which the standards that accepted by the authority are acceptable to be involved as an uplift of the carrier. For instance, the organisation that comply to diversified standards, approvals and recognitions of the other tier of standard such as an aircraft owner in Europe is looking for an affordable price of the package that willing to pursue with higher ability to effort in a lower budget might searching an air maintenance organisation that be able to pursue the desired technical package in the exact quality and safety within capacity to comply to the documentation procedures and processes that the aircraft belong upon the recognition of the aircraft authority. Therefore, aircraft maintenance organisation that capable to accomplish the mentioned task may determine this as a competitive advantage of an ability to pursue maintenance towards various aircraft registrations based by recognition and monitorisation of the authority that the organisation hosted to.

## **6.1 Achievement**

Since safety and quality is another main priorities towards aviation industry. By illustrating structure, framework, module and relevant requirements of minimum standards that applied to aeronautic maintenance organisation improves more vision that can be visualised towards quality and safety systems in the enterprise that integrated towards various sub-systems from supplier to the release the product back to service. Therefore, by emphasising the relevant information is narrowing down the diversified regulations, standards and certifications in terms of quality and safety management systems in aeronautic maintenance organisation from various standards, which it is predictable that the creation shall visualise structure, perspectives, path and framework with comprehension towards initial period of the organisation, which recurrent of the approval shall be complying to Part CAMO or Part Continue Airworthiness Maintenance Organisation. Moreover, it is considered as an achievement to gather and visualise an update and knowledge of the safety and quality management systems in aeronautic maintenance organisation that is full of potential to grow.

## **6.2 Future work**

As can be seen that integrated quality safety management system has been moulded seamlessly but it is a start of a firm standard era that packed the organisation together by the system that being enforce by authority, which prioritising safety as quality towards operation and management. As continuously improvement is a key of quality, the system itself also required to continuously develop as well as safety. In this dissertation has been illustrating ISO 9000 series, ISO 45001:2018, Annex 19 Chicago convention Safety Management System and other relevant approvals, which in the near future the standards may be updated in order to resist with necessary internal and external factor that force to comply. Therefore, further study should be done in this subject as well as Part CAMO or Continuing Airworthiness Management Organisation as known as certification of approval that certified the carrier is permitted to manage and oversight the continuing airworthiness of the aircraft. As well as Part M or continuing airworthiness of aircraft parts, components and other relevant products that being operated to the aircraft together with the personnel who pursue the task, since the carrier shall obtain the mentioned approvals in order to maintain an aircraft continuously. Quality and safety are crucial to the air maintenance organisation and it worth to continuing research and develop, since it minimising the gaps of error that may be revealed, prepare organisation to resist with internal and external friction that may be occurred.

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