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Architecture System Framework for a Continuing Airworthiness Management Organization

Célio Manuel Pereira Moreira

Dissertation presented as partial requirement for obtaining the Master's degree in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

BOOK SPINE

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ARCHITECTURE SYSTEM FRAMEWORK FOR A CONTINUING AIRWORTHINESS MANAGEMENT ORGANIZATION

by

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Dissertation presented as a partial requirement of the degree of Master of Information Management, with a specialization in Information Systems and Technologies Management

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And thank you to all the people I've been learning from throughout my life.

"If the path be beautiful, let us not ask where it leads."

Anatole France

ABSTRACT

International Civil Aviation Organization (ICAO) main goal is to increase safety of global aviation. To pursue such goal, a Global Aviation Safety Plan was issued. This document highlights the importance of Safety Management System (SMS) requirements compliance by aviation stakeholders.

At regional level, European Union Aviation Safety Agency (EASA) issued the European Plan for Aviation Safety which identifies the strategy and the enablers for the near future. This includes the implementation of SMS on aviation industry, but also identifies the importance of digitalization and technology to improve safety level.

In industry, having an enterprise architecture helps Organizations to have a systematic approach to ensure Processes, Information and Technology architectures alignment. Technology shall be used to improve the processes to a higher level of effectiveness and efficiency, producing the information effectively needed by different organizational levels. So, the question that arises is how can Continuing Airworthiness Management Organizations (CAMO) leverage its business, promoting safety and bringing value to stakeholder's expectations?

The goal of this dissertation was to promote the development of a high-level CAMO architecture system framework which complies with applicable SMS and airworthiness regulations. To meet this goal, three data vectors will be analyzed: the organizational architectures, the airworthiness CAMO requirements and the data provided by studies on how technology is leveraging industrial aviation. This will allow the identification of which business processes and compliance information are required and enable the discussion of which applicable architecture model should be more effective.

The study led to the Architecture System Framework components proposal within the Continuing Airworthiness Management Organization, namely the Business Process architecture, the Information architecture and the Technological enablers guidance proposals. The Business Process architecture proposal is divided trough 3 processes levels that includes 8 level 1 processes, 31 level 2 processes and a third level where each of the level 2 process was designed using BPMN detail approach. To design Information Architecture was used DFD notation where 11 high level data entities repository were identified, evaluated and proposed.

In the end of this work and using the identified technological enablers applied to aviation industry at the moment, it was discussed how these technologies could leverage the identified processes. Then it was developed a technological guidance scheme where was integrated the identified processes with the possible technologies to be used.

KEYWORDS

Aircraft Airworthiness; Continuing Airworthiness Management Organizations; Safety Management System; Business Process Architecture; Information Architecture; Architecture System Framework; Business Process Management Notation; Data Flow Diagram.

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LIST OF ABBREVIATIONS AND ACRONYMS

AD	Airworthiness Directive
ADM	Architecture Development Method
AMC	Acceptable Means of Compliance
AMP	Aircraft Maintenance Program
AI	Artificial Intelligence
AR	Augmented Reality
AW	Airworthiness
BPMN	Business Process Management Notation
CAD	Computer Aided Design
CAME	Continuing Airworthiness Management Exposition
CAMO	Continuing Airworthiness Management Organization
CAO	Combined Airworthiness Organization
CMPA	Complex Motor-Powered Aircraft
CPS	Cyber-Physical Systems
CRS	Certificate for Release to Service
DFD	Data Flow Diagrams
DNDAF	Canadian Department of National Defense Architecture Framework
DOA	Design Organizational Approval
DODAF	United States Department of Defense Architecture Framework
EASA	European Aviation Safety Agency
ER	European Regulation
ERP	Enterprise Resource Planning
EU	European Union
FAA	Federal Aviation Administration

FEAF Federal Enterprise Architecture Framework

GASP Global Aviation Safety Plan

GEAF Generalized Enterprise Architecture Framework

GERAM Generic Enterprise Reference Architecture and Methodology

GM Guidance Material

HR Human Resources

IATA International Air Transport Association

ICAO International Civil Aviation Organization

IEC International Electrotechnical Commission

IEEE Institute of Electrical and Electronics Engineers

IFR Instrument Flight Rules

IoT Internet of Things

IPC Illustrated Parts Catalogue

IS Information System

ISO International Organization for Standardization

IT Information Technology

JAA Joint Aviation Authority

KPI Key Process Indicator

MEL Minimum Equipment List

MMEL Master Minimum Equipment List

MES Manufacturing Execution Systems

MODAF British Ministry of Defense Architecture Framework

MRO Maintenance and Repair Organization

MTOM Maximum Taking Off Mass

NAF NATO Framework Architecture

PDCA Plan, Do, Check and Act

SIPOC Supplier, Input, Process, Output and Costumer

SMS Safety Management System

TOGAF The Open Group Architecture Framework

UML Unified Modelling Language

VFR Visual Flight Rules

VR Virtual Reality

1. INTRODUCTION

1.1. BACKGROUND

The global aviation system is composed by a complex group of stakeholders such as Regional and National Authorities, Operators, Manufactures and Maintenance and Repair Organizations. These Organizations are connected by several activities that must comply with various requirements to assure the safe operation of the aircrafts. For International Civil Aviation Organization (ICAO), safety is the main goal for general aviation (ICAO 2020). ICAO defines safety as "the state in which risks associated with aviation activities, related to or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level" (ICAO 2016).

To promote the vision of achieving the "goal of zero fatalities in commercial operations by 2030 and beyond", ICAO issued the 2020-2022 Global Aviation Safety Plan (GASP) with the mission to "continually enhance international aviation safety performance by providing a collaborative framework" (ICAO 2019). ICAO defines a strategic Organizational challenge roadmap initiative to promote safety, establishing a set of actions to be performed by all the stakeholders in the aviation system. Specifically, to Aviation Industry, are defined 12 safety enhancement initiatives through 2 different components:

- The State Safety Oversight System component that defines actions to identify safety gaps and to promote the improvement of compliance with the regulations.
- The State Safety Program that issues several actions to be taken by industry, to promote planning, implementation and compliance of the Safety Management System (SMS)(ICAO 2019).

According to ICAO, SMS provides the base of the proactive safety strategy to achieve the desired safety goals. ICAO defines SMS as the "systematic approach to managing safety, including the necessary Organizational structures, accountability, responsibilities, policies and procedures" (ICAO 2016).

At a regional level, European Aviation Safety Agency (EASA) is responsible to define the regulatory system, the certification of products and organizations process and to support Member States in terms of safety. For this purpose EASA has exclusive competence in terms of airworthiness regulatory definition (EASA 2020f). This regulation is divided by areas of implementation and is composed by hard law and soft law. While soft law is composed by guidance specifications, hard law determine the requirements to be implemented (EASA 2020c). This regulatory structure defines the organizational and product requirements that aeronautic industry of member states has to comply to operate, to manage aeronautic products life cycle or to manage the air traffic and navigation services and must to be adopted by organizations, persons and products involved in civil aviation activities to guarantee the expected level of safety (EASA 2021b).

Being part of the EASA regulatory structure, the regulation (EU) No 1321/2014 defines the requirements for the "continuing airworthiness of aircraft and aeronautical products, parts and appliances and on the approval of Organizations and personnel involved in these tasks". According to this document, continuing airworthiness is defined as "all of the processes ensuring that, at any time

in its operating life, the aircraft complies with the airworthiness requirements in force and is in a condition for safe operation" (EASA 2021b). For this purpose, this document has eight annexes with different application scopes called Parts. For this thesis, it will be considered the annex relative to the Continuing Airworthiness Management Organization (CAMO) of this document that specifies "the conditions to be met by the persons or Organizations involved in such continuing airworthiness management". with the purpose to define "measures to be taken to ensure that airworthiness is maintained" (EASA 2021b).

To support GASP objectives and priorities, EASA issued the European Plan for Aviation Safety (EPAS) 2020-2024. This document defines EASA's strategic priorities and enablers to meet GASP objectives at a regional level. The first defined priority is the systematic safety approach, which defines that one of the key actions to improve safety management is the incorporation of the Safety Management System (SMS) requirements with reference to ICAO Annex 19 - "Safety Management System" in initial and continuing airworthiness. This will promote changes to the regulatory structure as is today and will required industry to adapt (EASA 2019). With the intent to define a framework for the initial and continuing airworthiness scope with SMS requirement integrated, it was established a plan of regulation evolution to be approved for the continuing airworthiness full scope (EASA 2020e). Nevertheless, regulation (EU) 2019/1383 of 8 July 2019 already introduced SMS alignment with the CAMO requirements (EASA 2020d).

EPAS also identifies digitalization as a strategic enabler that is already transforming the aviation sector. However, actions must be taken to promote the full digitalization potential, in terms of regulations and requirements so that new business models can arise. With this purpose EASA objective is to converge a robust industry-wide information management framework that can use technology like Internet of Things (IoT) and Artificial Intelligence (AI) allowing to process data and advanced analytics capabilities (EASA 2019). At this level, Aviation 4.0 is bringing a new revolution at automation level, digitalization and data exchange. This concept comes from Industry 4.0 but applied to aviation. Industry 4.0 is stated as the fourth industrial revolution due the automation level of automation, data processing and communication speed exchange that IT came to provide. The use of technology such as IoT, cloud computing, machine learning and big data analytics, enables the introduction of smart products, the refinement of processes turning them intelligent processes in an integrated approach which can bring value to the aviation business (Valdes and Gómez 2018). Aviation 4.0 can be an enabler for the development of continuing airworthiness management and maintenance services, automating tracking, improving value chain, which will reduce operational aircraft downtime cost, but also increasing safety and reducing the burden of regulation compliance (European Commission 2017).

The constant search for increasing the global aviation level of safety means that there is a need for continuing requirement development. Industry has the challenge to fulfill the client and the business expectations, but also to comply and continuously adapt to the issued requirements in a schematic approach and shall be capable of showing compliance. On other hand, the use of technology and digital innovations can help to have an increased awareness of the level of safety. Improving the collection of airworthiness, maintenance and operational data, the automation of the processes and higher processing capability can change how industry performs, supply chain flows, how maintenance, repair and overhaul is schedule and performed and also how aircrafts and components are controlled during their life-cycle (IATA 2018).

Thus, with the continuing airworthiness management an essential activity to guarantee aviation safety the question that arises is which Organization architecture framework may leverage a CAMO to bring value to the stakeholder's expectations in terms of safety?

1.2. MOTIVATION

To accomplish the aviation authorities' objectives, industry Organizations will have a massive challenge in the near future. They will have to adapt the Organizations strategy and structure to comply with SMS requirements, maintaining the compliance with safety requirements but also adapting the processes and products transformations that digital technology brings. In particular, for Continuing Airworthiness Management Organizations, there are several challenges to overcome. The compliance of CAMO requirements in an efficiency way, the integration of SMS requirements in the Organizations processes and the use of digital technologies are an opportunity for Organizations to adapt, to establish more demanding goals, bringing more value, but with high levels of safety (EASA, 2019b).

An enterprise architecture allows companies to keep the alignment of all the elements required for an Organizational transformation, providing the right structure of relevance issues and assets to perform these changes. The right alignment between Business Architecture, Information Architecture, Organizational Architecture, Application Architecture and Technological Architecture allow the Organizations to be always assessed and controlled (Sousa et al. 2005). This also can be an enabler to guarantee the constant compliance with the requirements, bringing more value to the stakeholders and have a more efficient continuous improvement approach regarding opportunities and the environmental changes (Sousa et al. 2005). In fact, the enterprise architectures management promote the transparency of the Organization trough the different identified business layers in a documented and structured way, as also permit the continuous alignment, control and adjustment of the IT(Edwards et al. 2012).

In aviation sector, having this systematic approach will allow Organizations to produce value self-awareness and safety data that can be shared giving the necessary contribution to decrease the risk level in the aviation system and increasing safety as required by all the entities. In an aviation Organization the use of technology can provide breakthroughs from the management level where risk evaluation can be automated and smarter until the operational level where predictive maintenance of an aircraft can be optimized and integrated with maintenance or with logistics. Therefore, a system architecture oriented for a CAMO, supported with the use of technology, perfectly aligned with the information and data required, will surely bring a high level of improvements. This means an effective exploration of real-time data which can provide a more flexible, quick and better decision making; a real awareness acknowledge of the organization, improvement of goals definition and control; a more efficient maintenance management that leads to a higher level of aircraft availability decreasing turnaround time for schedule or unscheduled maintenance (Candell, Karim and Söderholm 2009). All these aspects directly contribute to Organizational safety management improvement.

1.3. OBJECTIVE

The organizational architecture of company depends on each company vision and objectives. However, the standardization of the business process and informational architecture can provide a valuable roadmap to organizations requirements compliance and self-improvement and risk awareness. Hence, the goal of this dissertation is to promote the development of a high-level CAMO architecture system framework that complies with applicable SMS and Airworthiness (AW) regulations, trough the development of a process and information architecture proposal. This will be held by:

- Regulations analyses and requirements identification.
- Identification of the high-level process architecture required for requirement accomplishment.
- Description of each process crosschecking with applicable requirement.
- Identification of the information architecture required for requirement compliance.
- Description and analyses of each identified informational entities.
- Identification of the technological enablers that can leverage process optimization and data collection.

2. METHODOLOGY

To achieve the goal of this study it will be followed a methodological path divided in three different phases: exploration phase, analytical phase and conclusive phase. Each phase is divided by specific steps as identified in figure 1 that will allow achieve the proposed specific goals for this thesis.

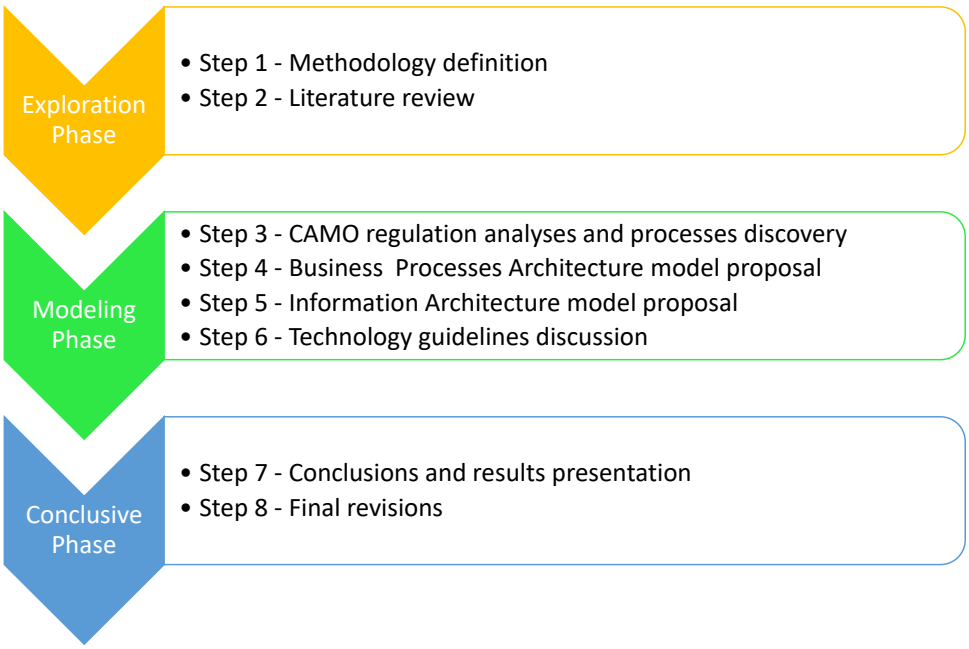


Figure 1 - Methodology

In the exploration phase, after establishing the methodology required, it will be carried out the literature review, to identify the theorical basis for this study. This review considered three principal issues: identification of the principal advantages of having an architecture framework; identification of CAMO framework and overhaul structure requirements determined in the regulation; and the identification of how technology is already and how it will change management of aviation industry, aircrafts and components life cycle. During this stage, were also identified previous works could contribute to this study development.

In the modeling phase, the CAMO regulation requirements will be analyzed, treated, and presented in a schematic approach. This evaluation will be done through documental analyses, namely using as base the EASA regulations requirements. The goal of this evaluation is to discover which processes may be used that can integrate the CAMO requirements. This will be developed through the following:

- Evaluate the requirements in terms of organizational levels required and identify the necessary activities to be performed.
- Identify the information, documents, and records required that a CAMO must manage.

From the literature review, will be identified the technology breakthroughs data that may support and leverage airworthiness management activities and processes and that will be considered in the architecture guidelines discussion:

This approach takes this work to have the data collection model systematized on the following figure:

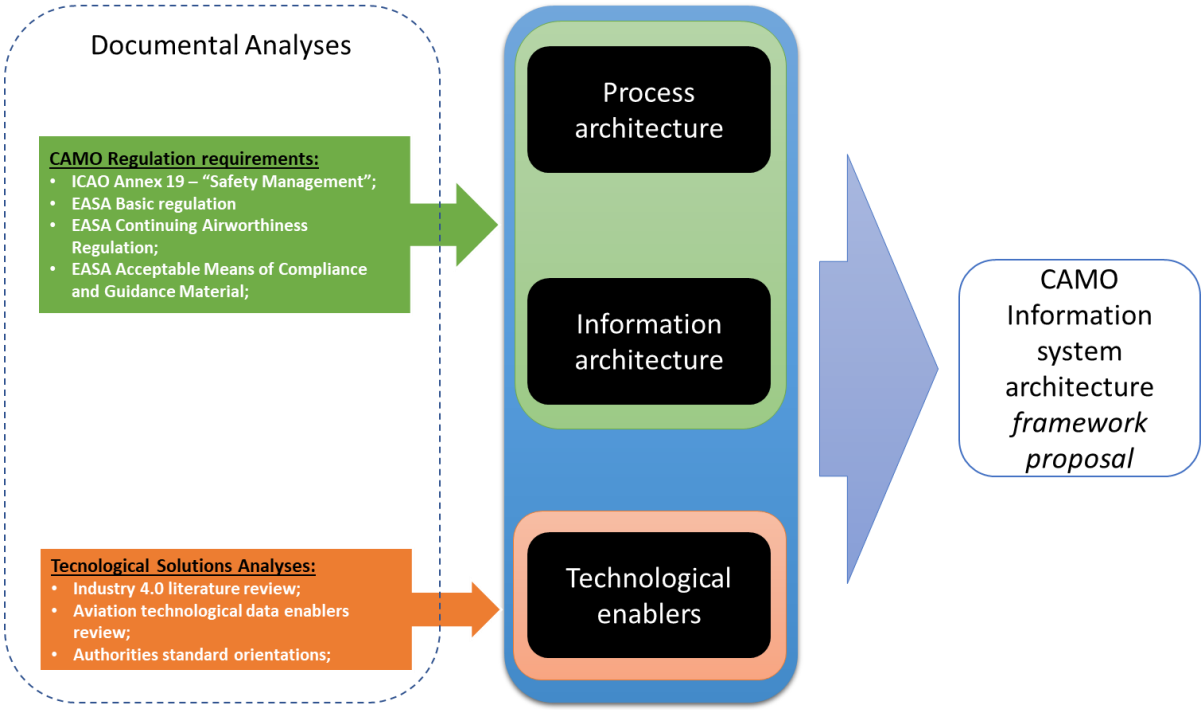


Figure 2 - Data collection model

With this data it will be possible to analyze and discuss the proposal of a high-level process architecture and an information architecture needed so that CAMO can ensure the compliance with the airworthiness and SMS requirements. The collected data will allow the identification how technology can leverage these architectures. The correlation of the identified architectures will provide the architecture system framework bases that can bring more value for the purpose of CAMO.

In the conclusive phase, the proposed architectures will be discussed and will be evaluated its compliance with the requirements. In the end of this study, it will be identified the principal conclusions obtained, the limitations of this approach, the contribution of the work for the knowledge and the future studies recommendations.

3. LITERATURE REVIEW

3.1. INFORMATION SYSTEMS ARCHITECTURES REVIEW

3.1.1. Enterprise Architecture concept

In the 80s Zachman defined Enterprise Architecture as a set of representations required to describe a system or an Organization in accordance with their structure, maintenance and evolution (Zachman 1987). Afterwards, Egan presented the Enterprise Architecture as a model which can be used by all in an Organization to check how things are being managed, facilitating the work and the development of new projects (Egan 1988).

Later in 2004, Schekkerman introduces a more complete Enterprise architecture concept, defining it as a global plan that "acts as a collaborative force" in all business aspects in relation with:

- The business planning such as "goals, the vision, strategies and governance principles";
- The business operations, as "the terms, the structure, the processes and the data";
- The automation aspects as "the information systems and databases";
- The existents capabilities in terms of technological infrastructure "as the computers, operating systems and networks" (Schekkerman 2006).

In 2005, the Meta Group defined Enterprise Architecture as "the holistic expression of an Organization's key business, information, application and technology strategies and their impact on business functions and processes". This approach considers business processes, the structure of the Organization and what type of technology is used to conduct these business processes (Sousa et al. 2005).

The original architectures concepts were developed about the manufacturing enterprises that had begun the reference architectures. With the terminology evolution, it was generally accepted that these reference architectures were called as framework architectures. Reference standards were developed with the Generic Enterprise Reference Architecture and Methodology (GERAM) and later the ISO 15704 - Enterprise modelling and architecture — "Requirements for enterprise-referencing architectures and methodologies" which defines a toolbox of concepts for enterprises life cycle. Currently, GERAM is generally known as the Generalized Enterprise Architecture Framework (GEAF).

Handley and Smillie describes that an Architecture Framework ensures a common approach to the development, presentation and integration of the architecture descriptions. The assumption is to guarantee that these descriptions can be understood within the Organizations boundaries. The application of a framework is able to guarantee the development of interoperable systems (Handley and Smillie 2008).

For the NATO Architecture Capability Team an Architecture Framework is "a specification of how to organize and present an enterprise through architecture descriptions". In other hand, ISO/IEC/IEEE 42010 defines the same concept as "the conventions, principles and practices for the description of architectures established within a specific domain of application and/or community of stakeholders"(North Atlantic Treaty Organization 2018).

To Sousa et al, all the general Architecture Systems definitions share a common concern: The Organizational architecture is related to the structure of all the elements that are relevant to the Organization, its components and how the components are adapted to the need and work in an integrated way to fulfil a specific purpose. According to the same authors, the first step in defining the Organizational structure model is to establish the properties that the model holds, the perspectives and views that must exist so that the properties can be properly designed. The Organization's concepts and models must be simple and coherent so that they can be communicated, analyzed and discussed (Sousa et al. 2005). In fact, an enterprise architecture is a way to simplify, make it understandable and give a common sense in the Organizations domain. Each Organization should develop their concepts based on shared structure that all the collaborators can understand (Bernus and Nemes 1996).

Each of these definitions provides a clear understanding of the Enterprise Architecture Framework concept. In resume, it is assumed for this work that an architecture framework is a common toolbox of principles, definitions and standards which able an Organization to commonly and simply describe how is their structure, their functions, their technology assets and processes, how is organized within their scope and limitations in order to achieve the business visions and goals.

3.1.2. Enterprise Architecture frameworks

In the end of the 70s, there was a great effort from the manufacturing industry to automate their systems, with a great evolution in their processes from planning to production control. As a result, there was a great need to integrate the new tools and methods that could integrate the information and material flow through the Organizations. In this scope generic models were developed and denominated architectures. The purpose of these models was to implement Information Systems (IS) where the information processing tasks of a company could be integrated. This approach had taken organizations to the development of stable packages software. Then, these software's full integration led to the development of Enterprise Resource Planning (ERP). Meanwhile, the manufacturing industry developed specific models as the Manufacturing Execution Systems (MES) without a great final acceptance (Bernus, Noran and Molina 2014). Recent developments tried to create interfaces between MES systems and ERP systems, like the standard IEC 62254.

With time, the architecture model evolved in a way that started to include the Organization life cycle. This had led to the integration of all the activities needed for companies develop their mission (Bernus et al. 2014). It was in this context that Bernus and Nemes established the first Enterprise Architecture reference called Generalized Enterprise Reference Architecture and Methodology (GERAM) (Bernus and Nemes 1996). This model was the bases of the ISO 15704 standard , "Requirements for Generalized Enterprise Reference Architectures and Methodologies" where are defined the requirements which any Organization may develop its architecture (ISO 2000).

During the 80s, Zachman proposed an Architecture Framework initially oriented to the companies Information Systems, but consequently generalized to all enterprise architecture and their life cycle, which become one of the most recognized frameworks. The Zachman Framework uses a matrix that crosses different user roles organizational perspectives in the vertical axes with their different domain concerns in the horizontal axes (Zachman 1987). The Zachman perspectives and concerns are resumed on the following table:

Table 1 - Zachman perspectives and concerns (Adapted from Sousa et al. 2005)

Perspectives	**Scope (Planner's perspective)**	Defines the Organization strategy approach and the internal and external environment.
	Enterprise Model (Owner's perspective)	Defines the business, the processes and Organizations deliver value.
	System Model (Designer's perspective)	Defines the Organization as system in order to accomplish the owner's expectations
	Technology Model (Builder's perspective)	Defines how the Organization uses the technology for the business purpose.
	Detailed Representations (Subcontractor's perspective)	It concerns the necessary builder's specifications of the system components to be subcontracted (internally or to third parties).
Concerns	**Data (what)**	The objective is to define which information is required to Organization.
	Function (how)	This concern is about defining how the mission of the Organization will be performed in detailed way according with its operations.
	Network (where)	It defines the geographical distribution of Organization activities and how they are associated.
	People (who)	Describes the unit, the area or role that is related to a specific activity, task or function.
	Time (when)	Describes when each task, perspective or action must be performed in time.
	Motivation (why)	Defines how each action is related to each goal and objective of the Organization.

The following figure shows the Zachman framework model perspectives and concerns crosschecked:

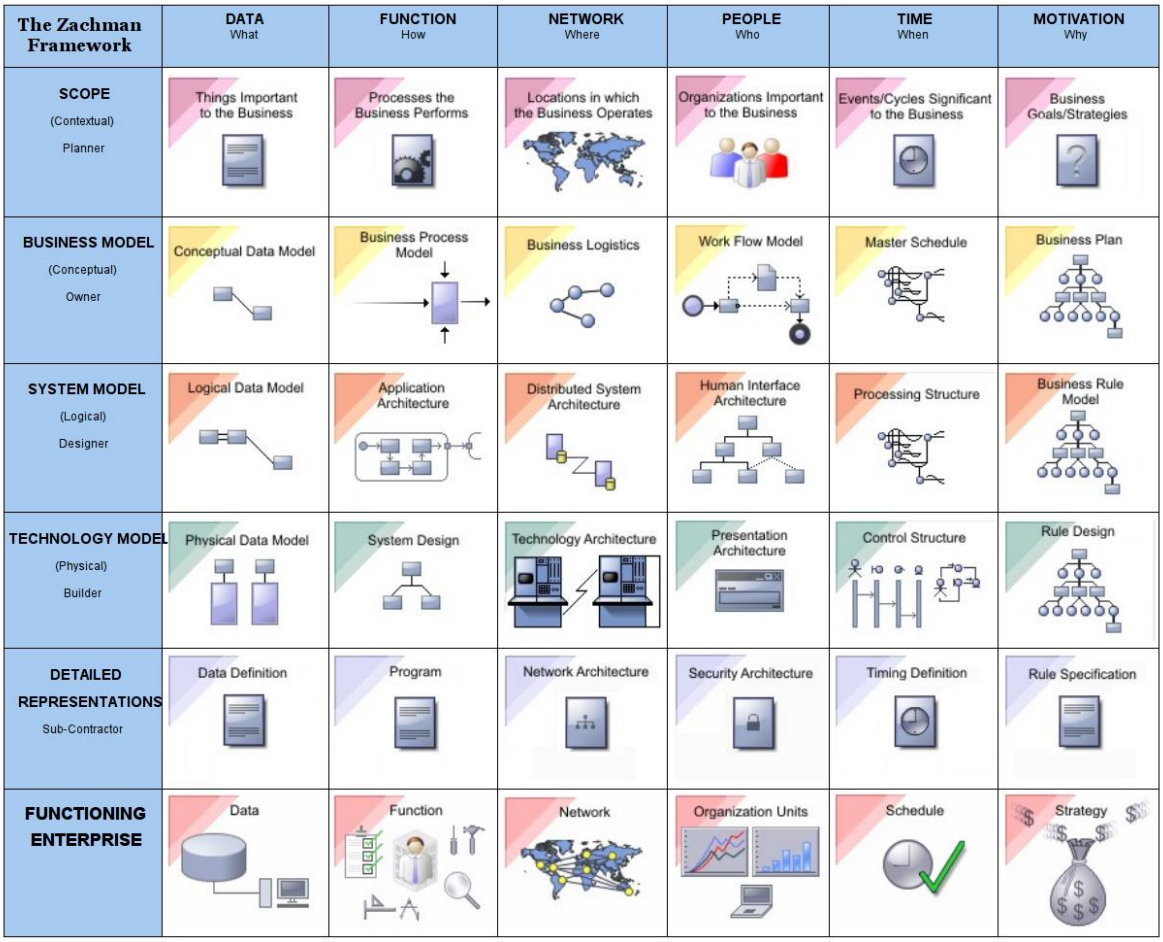


Figure 3 - Zachman Framework (Sparx Systems Pty Ltd. 2020)

This framework provides an overall view how a company can develop and document the enterprise architecture. As it's possible to verify on figure 3, for each cross-cell Zachman suggests a different model approaches to describe each of the business elements like processes or information model. However, this framework does not define a metamodel that integrates or trace each cell information. Along the years, this framework had several adaptations and evolutions like the Federal Enterprise Architecture Framework (FEAF).

The IT industry also developed a framework denominated TOGAF - The Open Group Architecture Framework which won a great popularity in IT consulting (Bernus et al. 2014). This framework has a modular structure that supports greater usability that can have an incremental adoption and a guidance material to support their application. The content of the framework is composed by 3 principal perspectives: The Architecture Development Method (ADM) which is an iterative development method to approach to the specific business needs; the Enterprise Continuum which provides reference models; and the resources bases which provides the development guidelines (The Open Group 2021).

The ADM method provides a continuous delivering architecture framework process which able Organizations to continuous follow their vision, adapting the architecture to the required goals:

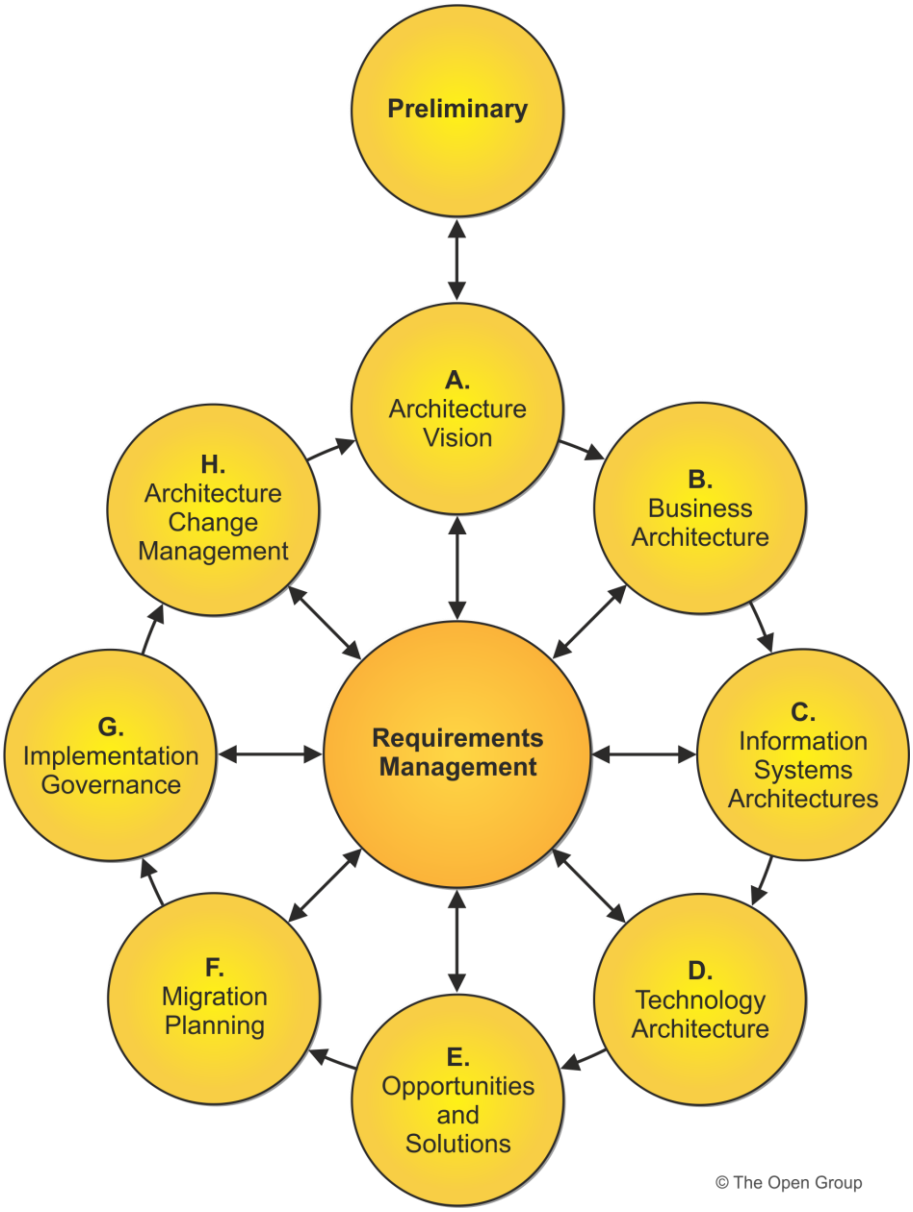


Figure 4 - TOGAF development process (The Open Group 2021)

Each of these steps are described as follows:

Table 2 - TOGAF kinds of architectures (Adapted from North Atlantic Treaty Organization 2018 and from The Open Group 2021)

TOGAF Architecture	Description
Preliminary	In this phase all the setups shall be made, preparing the following phases, identifying deliverables, capabilities repository, team members and skills.
Architecture Vision	It shall describe the global vision, the existing capabilities and the required capabilities. It shall include the capabilities increments needed to be integrated in systems or projects.

Business Architecture	It shall describe the structure and interaction description between the business strategy organization, functions, business processes and information needs.
Information Systems Architecture	It shall describe how the information systems are aligned and are an enabler for the business accomplish their mission in straight alignment with the vision.
Technology Architecture	It shall describe the technology *assets* and respective procedures to implement and develop solutions.
Opportunities and Solutions	In this phase it should be evaluated the current state, the required state, the gap between them and solutions that can be provided shall be indicated.
Migration and Planning Phase	Elaborate and provide the necessary plan to develop the required solutions. It should be defined the responsibilities, the necessary resources and shall be identified the cost.
Implementation Governance Phase	In the governance phase, it should be guaranteed that the development architecture is being done in accordance with the plans.
Architecture Change Management Phase	In this last step, it should be identified improvements as required and change in necessary to obtain the required final architectures. Optimization of the initial plan can be provided.

In the defense scope, there were also developments of specific Frameworks. As a result of an restructuring phase of the IT area in the Department of Defense of the United States, it was developed the DODAF - United States Department of Defense Architecture Framework with the goal to define a structure for the development of an Organization or a system architecture that could be integrated and interoperable (Handley and Smillie 2008). This was the base to the development of other frameworks like:

- DNDAF - Canadian Department of National Defense Architecture Framework;
- MODAF - British Ministry of Defense Architecture Framework;
- NAF - NATO Framework Architecture.

Currently NAF is the reference for all NATO country. Having as referential standard the ISO/IEC/IEE 15288 - “Systems and software engineering - System life cycle processes”, NAF identifies five main processes architectures that can be used by different Organizations or projects that can be run simultaneously in accordance with the client expectations:

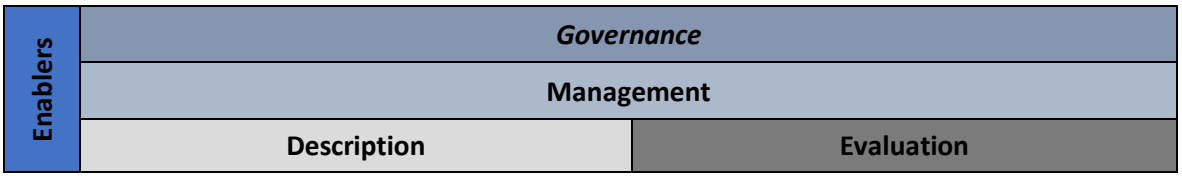


Figure 5 - NAF main Architectures (North Atlantic Treaty Organization 2018)

Each of these processes are described as following:

- Governance Architecture: This architecture is composed by the strategic activities that allow control of all the existing architecture according to the Organization's objectives. The person responsible for this process is usually some Organizational entity with responsibilities for the consistency of the existing architecture of the project or Organization. This person is essential for the direction of all activities and assets of the Organization;
- Management Architecture: This process aims to plan, execute and monitor architectures throughout their life cycle. It's intended to have architectures developed in accordance with the direction defined by governance so that it meets the expectations of stakeholders;
- Description Architecture: This architecture aims to analyze and identify the entire Organizational internal and external context; namely the purpose, the scope, the objectives, but also the stakeholders needs and concerns, providing solutions, methods and models to meet the defined requirements. This should be a way of demonstrating compliance with ISO/IEC/IEE 42010 - "Systems and software engineering - Architecture description";
- Evaluation Architecture: This architecture aims to define criteria, objectives and methodologies that allow evaluating and measuring what is intended within the built overall architecture. This architecture should comply with ISO / IEC / IEEE 42020 - "Enterprise, Systems and Software - Architecture Processes" and ISO / IEC / IEEE 42030 - "Software, systems and enterprise - Architecture evaluation Framework";
- Enablers Architecture: The purpose of this architecture is to define, maintain and improve the capacities, services and resources necessary for the rest of the process architectures to fulfil their mission.

For the architecture development, NAF uses as reference TOGAF's ADM process, however with some adjustments to comply the ISO/IEC/IEEE 42010 standard. This methodology allows some flexibility during the development phases to capture the data to motivate and establish the necessary activities for the architecture to develop, from the initial vision to the desired baseline. To achieve this goal, it should be established the necessary requirements: goals, expectations, constraints, drivers, risks, costs, value and opportunities. Using these elements, it's possible to change the architecture and redirect it to an architecture that brings greater value. Each of the phases can have several improvement and optimization cycles and this approach flexibility allows each phase to go back to the previous one if necessary. For each activity phase, data can be updated allowing to generate information updates of the dashboards as applicable (North Atlantic Treaty Organization 2018).

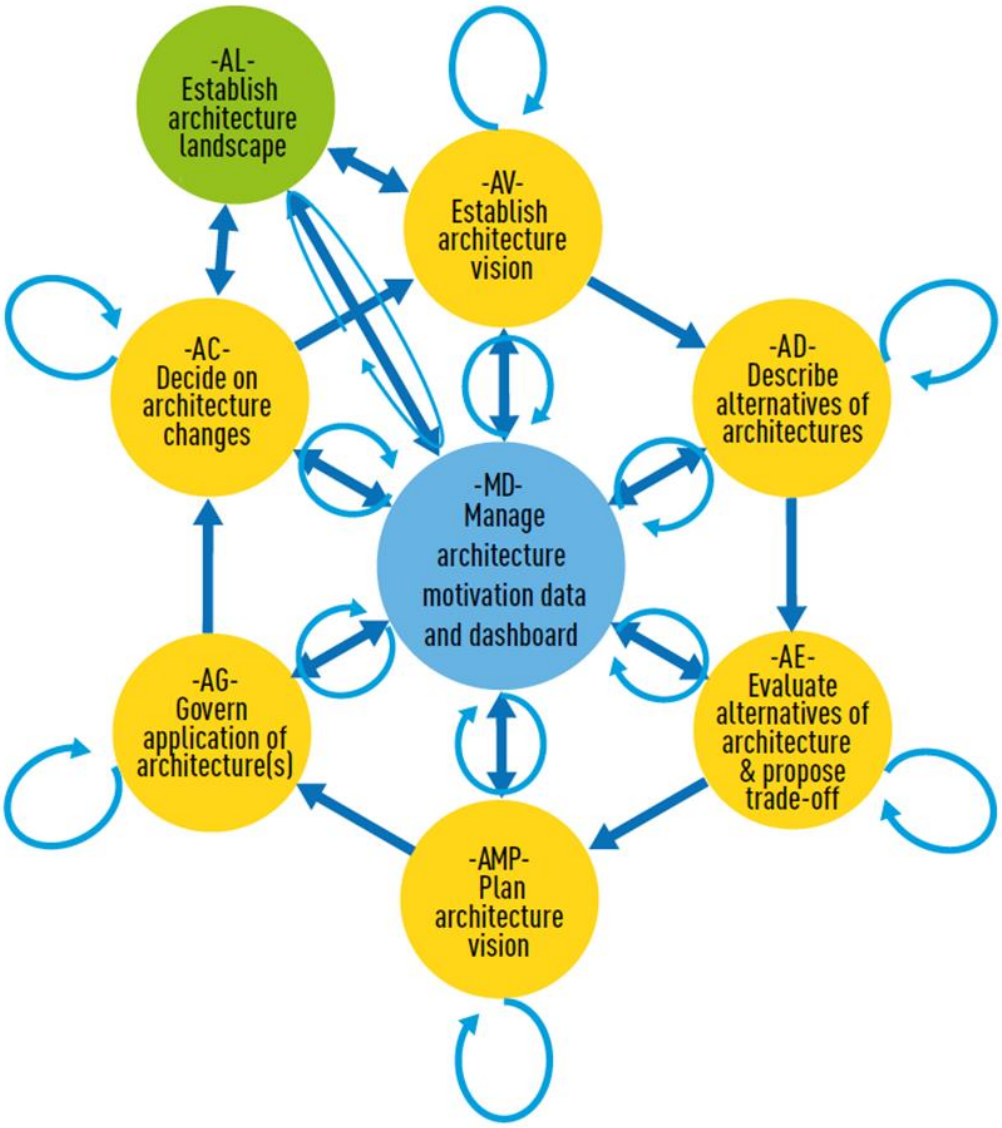


Figure 6 - NAF development phases interactions

Each of these phases are described on the following table:

Table 3 - NAF development phases description

NAF Phase	Description
Architecture Landscape	Describes the general context, the capabilities and means to develop the architecture.
Architecture Vision	Defines the vision of architecture considering the environment, the context and the times of the market (or the client).
Architecture Description	Describes the architecture of the stakeholders' Viewpoints according to the environment and identifies a set of alternatives for the evaluation architectures (Erder and Pureur 2016).

Architecture Evaluation	The objective of this phase to update the architecture evaluation criteria based on the motivational data that allows to evaluate each alternative, identifying the best architectures among the approved alternatives.
Plan Migration	Updates the architecture migration plan and provides the constraints and requirements for its applicability.
Architecture Governance	Guarantee the application of the best-evaluated architecture considering its suitability and in accordance with the migration plan, providing guidance to resolve conflicts.
Architecture Changes	Elaborates and guarantees approval of requests for architecture changes.
Motivation & Dashboard	It manages the architecture context, constraints, drivers and makes the progression of the architecture status transparent, as well as the dependencies with other architectures through a dashboard.

Based on TOGAF and Zachman architecture Pedro et al. proposes a five-component enterprise architecture model that attains an alignment between business processes, information, support system and the existence technological assets (Sousa et al. 2005). These components are the Organizational Architecture, Business Architecture, Information Architecture, Application Architecture and Technological Architecture as is shown on the following figure:

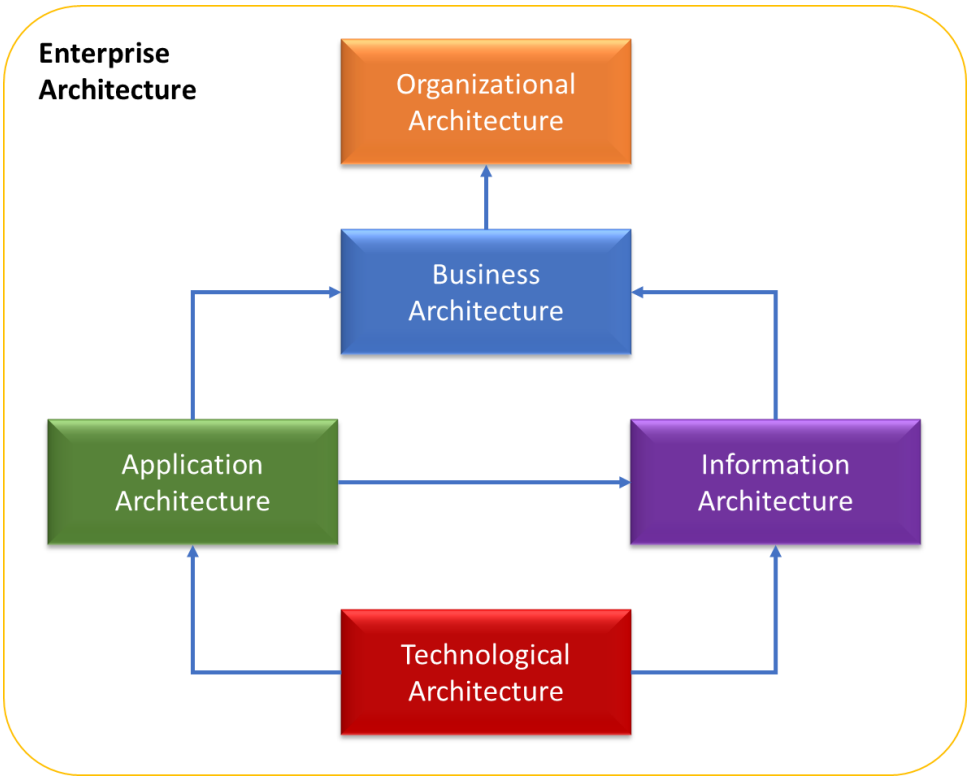


Figure 7 - Enterprise components interactions (adapted from Sousa et al. 2005)

Each of this architecture component is resumed in the following table:

Table 4 - Enterprise components descriptions (adapted from Sousa et al. 2005)

Pedro et al. model	Description
Organizational Architecture	This architecture shall describe the aspects related with the Organization top aspects like the mission, vision the strategy and the Organizational units. It's not related how the business is conducted nor with the processes used the value creation.
Business Process Architecture	This architecture shall describe and define which and how business processes interact with each other as results from the implementation of business strategies.
Information Architecture	This architecture shall be an abstraction of the information requirements needed for the business, to its processes and operations.
Application Architecture	This architecture shall define the applications needed for Data Management and business support and how they relate to each other, to support business requirements and management needs. It shall define the applications needed to the business architecture.
Technological Architecture	The technological architecture shall describe the technologies that support the business, the infrastructure and the entire environment needed. It shall be composed by the infrastructure, platform and application blocks.

In their description Pedro et al. details each of these architectures and emphasize the importance of their alignment as shown on figure 7. The Organizational architecture shall define de scope where Business and Information architectures shall be developed. In other hand, information and business architectures must be aligned to guarantee that each person, on each function have the information they need, on right time and with the adequate level of detail. Application Architecture must be designed in order that extras tasks are no needed, the data is introduced in one way only and the information is available for different levels of the company when required and when needed without replication needed (Sousa et al. 2005).

Although having different perspectives, approaches, methodologies and level of details, all these architectures reveal the importance of defining an enterprise architecture. Having a framework can lead companies to a better self-comprehension of the real status of the Organization, a better way to lead with the required change to follow the vision, accomplish the mission and achieve the goals. The different approaches, although don't detail all the way, identify the importance of having high level of abstraction of the Organization also that all can understand how the companies are build and which is it scope. They also reveal the importance of defining the structure in detail for each level to understand what their function in the entire structure is.

These frameworks have a direct impact in Information Systems, namely they reduce the complexity, assuring their durability, flexibility and adaption to the business and clients' needs. Also promote a better integration and interoperation; faster and easier technological evolution; better alignment between business and the Information Systems and the Information Technology and improve efficiency with the development and maintenance of the systems (Vasconcelos et al. 2003).

All the frameworks, with more or less detail reveal the importance of having a definition of the business processes, information and technological assets architectures. In the scope of this thesis, the development will focus on these described views in order to achieve the defined goals. Within this purpose it will be used the definitions used by Pedro et al. in table 4.

3.2. AVIATION INTERNATIONAL REGULATION

3.2.1. The International Civil Aviation Organization

In 1944 was founded the International Civil Aviation Organization (ICAO) as a United Nation specialized agency through the signature of the Chicago Convention by 32 national states (ICAO 2021a). ICAO has maintained its actions until our days and today has 193 enrolled states. Currently, the objective is to guarantee the international cooperation, diplomacy, by supporting new policies and standards, which harmonize and improve the air transport safety and compliance. In this council, also participates regional or international Organizations, industry and civil group representatives, which contribute to the continuous improvement of these policies and standards. This provides a worldwide alignment to get a global safety and sustainable air operation exploration. Although ICAO develop aviation standards, this agency cannot supersede the national law and doesn't have legal authority empowerment capability. The ICAO responsibility is to help countries that assign this agreements to achieve and to embrace standards through diplomacy and consensus (ICAO 2021b).

So being, to promote ICAO objectives and standards, ICAO has the responsibility to issue, improve, maintain and control the annexes to the Chicago convention. Each annex covers a specific aviation area where are established requirements, recommendations and best practices that each ratifier country shall follow in order to harmonize the global aviation. The following table describe ICAO intervention area and respective annex (Skybrary 2019):

Table 5 - ICAO Annexes description resume (adapted from ICAO 2009)

#	Title	Description
1	Personnel Licensing	Define the overhaul rules for personnel licensing to all the human resources (air and ground) who intervene in civil aviation, since flights crews, maintenance or air traffic controllers. Also, establish the importance of human factors programs in aviation.
2	Rules of the Air	Defines the recommended rules and conditions so that the aircraft can be operated according to Visual Flight Rules (VFR) or Instrument Flight Rules (IFR).
3	Meteorological Services	The meteorological conditions are essential to fly in safety conditions, so this annex determine the meteorological service requirements so that the aeronautical users can perform their functions properly.
4	Aeronautical Charts	To standardize the appropriate information to all the airman, this annex defines how States shall make available aeronautical charts information and types. These charts are used to plan the taking off, in route and destination operations in the different type of operations.
5	Units of Measurement	This annex describes which unit of measurement shall be used in air or ground operation for each system.

6	Operation of Aircraft	The objective of this annex is to define minimum criteria for aircraft operations, procedures and also crew responsibilities depending on the type of flight, technology used and systems. This annex has 3 different parts depending on the type of the aircraft itself: commercial aviation; general aviation and helicopters.
7	Aircraft Nationality and Registration Marks	This annex defines how to classify, identify and registry an aircraft according to the different nationalities.
8	Airworthiness of Aircraft	The objective of this annex is to identify the requirements needed so that an aircraft can be designed, developed, produced, maintained and operated in accomplished with necessary airworthiness requirements. Each aircraft needs an airworthiness certificate that must be continuously controlled so that the aircraft can be considered fit to fly. This annex is divided in 4 parts with the following scope: definitions; certification and continuing airworthiness; technical requirements for certification; helicopters.
9	Facilitation	This annex defines requirement recommendations related with the infrastructures and general services to guarantee aircraft, passengers and cargo control entering and leaving the different states.
10	Aeronautical Telecommunications	This annex is composed by 5 volumes which define and recommend practices, procedures and a guidance material for the use of aeronautical communication, navigations and surveillance systems. This document aims these systems standardizations.
11	Air Traffic Services	This annex defines the general conventions to guarantee air traffic services as air traffic control, flight information and alerting services with the overall objective to prevent aircraft collisions in the air or in the ground, whatever the operation is VFR or IFR.
12	Search and Rescue	The Search and Rescue (SAR) annex is composed 5 chapters where are define the Organization, facilities and cooperative principles for SAR operations, preparatory measures and procedures.
13	Aircraft Accident and Incident Investigation	This annex defines the process and procedures required to conduct Aircraft Accident and Incident Investigation to identify the causes and prevent future repeated occurrences.
14	Aerodromes	This annex is composed by 2 volumes that defines the requirements to the design of aerodromes and heliports. They also establish the necessary equipment and needs to operate in these infrastructures.
15	Aeronautical Information Services	The Aeronautical Information Services annex defines how to manage (since de development to the distribution) the aeronautical information and data to guarantee the standardization of for operational use, whatever the type of operation is going.
16	Environmental Protection	Environmental Protection annex is composed by 3 volumes that define the overall requirements and specifications to protect environment on the following domains: aircraft noise, aircraft engine emissions and airplane CO_2 emissions.

17	Security	This annex is about the necessary coordination aspects that lead to the protection of the air transport security, defining which requirement the security programs shall comply and the measures to be accomplished. The objective is to guarantee passengers, assents and revenues protection.
18	The Safe Transportation of Dangerous Goods by Air	ICAO recognizes the importance of the transportation of dangerous goods so it was developed a specific annex where is defined all the requirements needed to guarantee a safety operation in handling this type of cargo. These specifications involve labelling, packaging and shipping procedures).
19	Safety Management	This annex was developed to guarantee the application of safety management requirements all over the Organizations that operate, manage or maintain aviation products in order to guarantee the safety levels.

In the scope of this thesis, it is important to describe in depth the principal requirements and principles that are in the bases of a CAMO. Therefore, in the following sub-chapters a more detail overview will take place over the ICAO Annex 8 and Annex 19, once they are in the origin of the responsibilities, processes and requirements that a CAMO must comply.

3.2.1.1. ICAO Annex 8 - Airworthiness of Aircraft

When an aircraft is designed, developed, produced and then operated it must be guaranteed the compliance with the airworthiness requirements of the state where the aircraft is registered. Each aircraft must have a Certificate of Airworthiness issuing that it's fit to fly within the required safety conditions. In this context is considered that an aircraft is airworthy. This means that the status of the aircraft, engine propeller or part complies with the approved design and is in condition to safe operations (ICAO 2009).

Hence, ICAO Annex 8 - Airworthiness of Aircraft objective is to harmonize the minimum standards that the states shall comply to guarantee safe operation, facilitating the bases of recognition so that aircraft can fly from, to and over different states territories. However, it is important to remember that this standard is not national regulation and is up to different states to define each basis of certification and make it national law which can be recognized by the other states (ICAO 2009). This annex is composed by four parts:

- Part I - Definitions;
- Part II - Procedures for certification and continuing airworthiness of aircraft;
- Part III - Technical requirements for the certification of new large airplane designs;
- Part IV - Helicopters.

Part I of ICAO Annex 8 has several definitions within this scope. Part III and Part IV is about technical airworthiness requirements that aircraft and helicopters must comply to operate in the required conditions. Therefore, these part's purpose is to set the minimal conditions for the acceptance of an aircraft as airworthy in its initial development and production. This means that it defines general standards about to performance, flying requirements, aircraft control, structures,

systems and equipment's design, installation, limitations or general information that must be provided by the constructors. (ICAO 2018).

Part II of this annex defines the general processes of certification and continuing airworthiness of each aircraft. According to Part I, aircraft continuing airworthiness is defined as "the set of processes by which an aircraft, engine, propeller or part complies with the applicable airworthiness requirements and remains in a condition for safe operation throughout its operations life". This means that continuing airworthiness aims to guarantee that the aircraft shall comply with full requirements established in the design and manufacturing phases to guarantee a safe operation during its life. The following chapters compose this part:

- Chapter 1 - The first chapter of this part is about type certification. According to ICAO Annex 8, Part I, type certificate is the "document issued by a Contracting State to define de design of an aircraft, engine or propeller type and to certify that this design meets the appropriate airworthiness requirements of that state". So being Chapter 1 of Part II defines how the type certification shall be issued, the conditions that must be complied and verified and all the rules to suspend, transfer or revoke the certificate as necessary.
- Chapter 2 - This chapter defines the general requirement that an Organization must comply to be approved for the production and manufacturing of aircraft, engine, propellers and parts. The states shall ensure that these Organizations comply with the established requirements and are approved for aviation scope production.
- Chapter 3 - This chapter describes how the certificate of airworthiness shall be managed in terms of eligibility, issuance and validity for each aircraft. This certificate guarantees and comprises that an aircraft is airworthy.
- Chapter 4 - This chapter defines what States must guarantee so that Operators may keep or renew that certificate. The scope goes from the definition of the information and the obligations of design and development States must provide so that the operator state can properly manage the continuing airworthiness of the systems. This chapter is in the bases of the need of CAMO to assure the aircraft operations in safety conditions.
- Chapter 5 - This chapter is about Safety Management System. Currently this chapter 5 only reference ICAO Annex 9 which is described on this work following paragraph 3.2.1.2.
- Chapter 6 - The objective of this chapter is to define the general requirements that a maintenance Organization must comply to be approved to perform maintenance of aircraft, engines, propellers and parts. It defines the necessary requirements about facilities, personnel, maintenance records, organization manual and procedures that are needed to keep aircrafts maintenance capability (ICAO 2018).

ICAO Annex 8 is the base that States shall follow to define more specific requirements that Organizations must comply to assure continuing airworthiness and recognition among peers.

3.2.1.2. ICAO Annex 19 - Safety Management

Due to the increase of complexity of the air transportation and with the intent to help States manage aviation risks and having a proactive strategy to assure safe operations, it was issued ICAO Annex 19 - Safety Management. This annex is a consolidated approach from the safety management references distributed from the other annexes and from the safety activities experience and knowledge developed a long time by the States (ICAO 2016). The Annex 19 is composed by five chapters:

- Chapter 1 - In this chapter it is exposed the main definitions within safety management scope;
- Chapter 2 - This chapter defines the document scope, which is applicable "to safety management functions related to or in direct support of, the safe operation of aircraft". This means that all the States shall ensure that safety management is included in each activity directly or indirectly related with the operation of the aircraft. This includes States, authorities, operators, industry and services providers.
- Chapter 3 - Defines the Sates responsibilities in the safety management through a State safety programme. This shall include a policy, objectives, the definition of specific functions and qualified resources to guarantee that safety activities are performed as required. States shall be capable of performing a state safety Risk Management. This includes the obligation of all service providers for aviation (training Organizations, operators, maintenance Organizations, design and manufacturing, air traffic services and aerodromes certified operators) to have the implementation of a Safety Management System. In accordance with chapter 1, a Safety Management System (SMS) is "a systematic approach to managing safety, including the necessary Organizational structures, accountability, responsibilities, policies and procedures". States shall also be able to perform accident and incident investigation, contributing for the cause's identification and be able to identify Hazard identification and safety risk assessment through the implementation of process and mechanism that permit data about safety issues. Other responsibilities include the assurance that safety program and policies are being accomplished and promoting safety for all the stakeholders involved.
- Chapter 4 - This chapter defines and enforces the need that all the services providers (operators, training, maintenance, design and manufacturing Organizations, air traffic services and aerodromes certified operators) shall have a Safety Management System within their Organization, having a proactive behavior identifying risk, issues and collecting data that enable Organizations to have a safety assessment. A Safety Management System have the following pillar bases (Figure 8):

    - Safety policy and objectives - This pilar defines that the organization shall be committed with safety through the defined policy and goals to be achieves; In this context, it shall be defined through Organizations the personnel safety

responsibilities, namely the key functions and document the processes and procedures necessary to achieve safety Organizational goals;

- Safety Risk Management - The Organization shall develop the necessary processes that enable the identification of hazards to its aviation products, the identification of risk and actions to mitigate and control those risks;
- Safety assurance - This pilar is about to guarantee that Organizations have mechanism that permit to measure safety performance indicators, validate the effectiveness of risk controls to assuring that policies are being followed up and objectives are being accomplished; Organization shall also promote continuous improvement of the SMS and guarantee which changes can affect the level of safety.

  Safety promotion - This pillar requires an Organizational approach to guarantee that all personnel have appropriate training and education about safety, are aware about this scope and there is a formal safety communication regarding SMS critical information, actions and procedures (Batuwangala, Silva and Wild 2018).

- Chapter 5 - This chapter defines identifies the importance of safety data collection (accident and incident investigations, safety investigations, safety reports) and processing in order to establish a safety information analyses that shall be protected and shared as necessary (ICAO 2016).

The following figure resumes the Safety Management System defined in the ICAO Annex 19, namely in the Chapter 4:

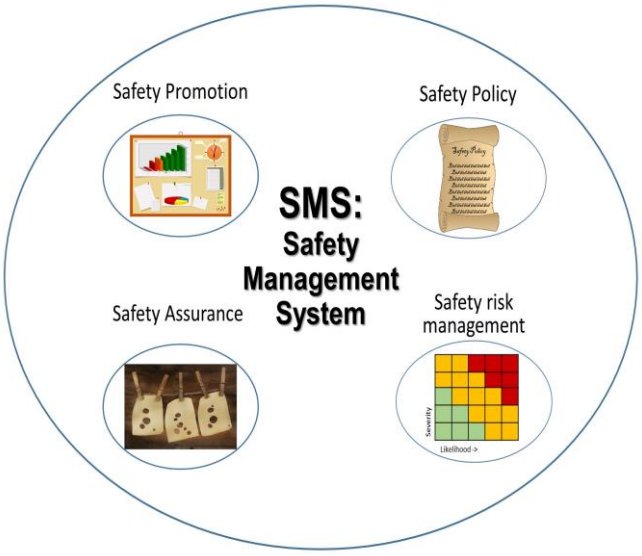


Figure 8 - SMS pillars (Aviation 2021)

ICAO Annexes, particularly the previously discussed annexes 6 and 19, define the guidelines that each State agreed to follow to harmonize and guarantee continuing airworthiness and having a proactive management approach to safe operations. On the following chapter it will be discussed how at regional level in European Union (EU) these guidelines are transformed to national law and which requirements CAMO must comply to be approved to perform their activities.

3.2.2. EASA regulation framework

In 2002 was established by the European Parliament the EASA, replacing the previous Joint Aviation Authority (JAA) (Skybrary 2019). This agency has the mission of ensure the “highest common level of safety protection for EU citizens”, the “highest common level of environmental protection”, guarantee a ”single regulatory and certification process among member States”, facilitate “the internal aviation single market & create a level playing field” and "Work with other international aviation Organizations & regulators” (EASA 2020b).

EASA is responsible for supporting and advising EU parliament to draft and approve aviation legislation. Unlike ICAO, EASA has law enforcement empowerment, which means that the rules issued by that agency have the force of law in EASA state members (EU, Switzerland and Norway). Once EASA is an EU agency and not a country cannot be an ICAO signatory. However, it works with ICAO and other entities like United States Federal Aviation Administration (FAA) to guarantee the standardization and harmonization of the best practices in aviation (Le and Lappas 2015). EASA regulation cover several aviation domains as the following regulatory framework shows:

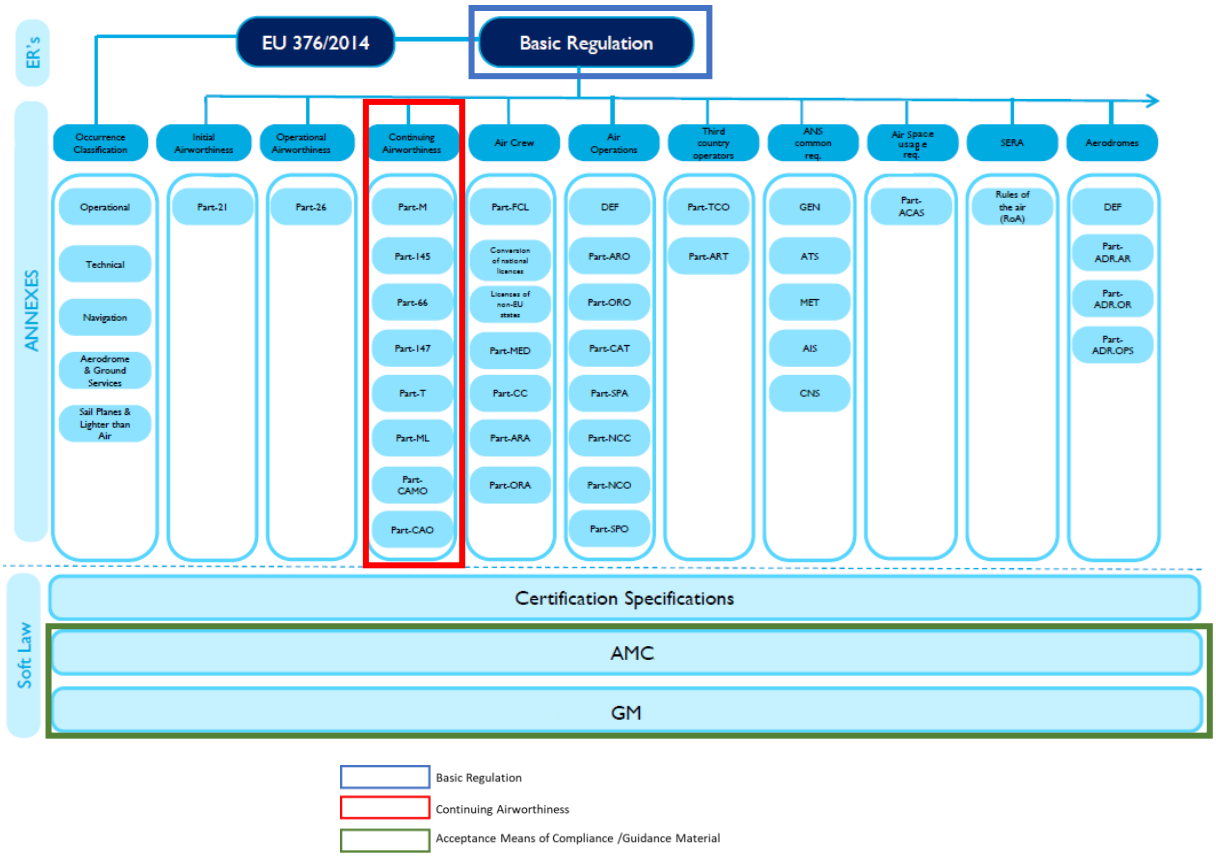


Figure 9 - EASA Regulatory Framework

EASA regulatory framework showed in figure 9 is composed by the European Regulation (ER) and the applied annexes for each implementation area. These regulations set up the hard law that each state member must comply and can be found in the upper area of the figure. In the lower area

are established the Certification Specifications, the Acceptance Means of Compliance (AMC), Guidance Material (GM) which establish the soft Law. This means that these specifications rules how the hard law can be complied but is not considered law.

The general top document that establishes the framework basic common rules as defines is Regulation (EU) 2018/1139 -"Common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency" of the European Parliament and is marked in blue in figure 9. This document defines the general rules of engagement of EASA as an EU Agency, its responsibilities and processes and have some common definitions for the whole framework.

In figure 9, with the red mark is possible to verify the continuing airworthiness annex and structure. The document that establishes this annex is the Commission Regulation (EU) No 1321/2014 - "Continuing Airworthiness". This annex is composed by the following parts:

Table 6 - Scope of Continuing Airworthiness Part (EASA 2021b)

Document	Description
Part-M	This annex defines the requirements that must be complied to guarantee that an aircraft is airworthy, maintains that status, including its maintenance (namely for aircraft not considered complex). It also defines the conditions to be me met by all the personnel involved in the tasks to be performed. This part is currently composed 2 sections with 9 subsections each. The first section is addressed to technical requirements while second section is about procedures for competent authorities. Currently this part is in change and some subparts are being replaced by Part-ML, Part-CAMO and Part-CAO.
Part-145	This annex defines the general requirements so that an organization can be approved and maintain that approval for aircraft and components maintenance.
Part-66	The objective of this part is to define the requirements needed to comply to be possible the issuance and maintain the validity of the technician's aircraft maintenance licenses that enable them to certify maintenance tasks.
Part-147	This part objective is to define the requirements for training and examination Organizations comply to be able to conduct and maintain the approval.
Part-T	In Part-T are defined the requirements which guarantee the continuing airworthiness of an aircraft/components installation that are registered in a third country where the regulatory safety supervision has not been delegated.
Part-ML	Part-ML defines the general requirements to guarantee that an aircraft is airworthy, specifying the requirements to be met by persons and applied organizations. The scope of Part-ML englobes only Light aircraft and is not applied to air carrier aircrafts. The scope of this part includes the following aircrafts requirements: ▪ Airplanes of 2 730 kg Maximum Take-Off Mass (MTOM) or less. ▪ Rotorcraft of 1 200 kg MTOM or less, certified for a maximum of up to 4 occupants. ▪ A sailplane or powered sailplane of 2 000 kg MTOM or less. ▪ A balloon. ▪ A hot airship. ▪ A gas airship.

Part-CAMO	This annex establishes the requirements for an organization be approved and maintain that approval to perform the continuing airworthiness management of an aircraft and components installation. The scope of this Organization can be applied for any aircraft, being mandatory to Complex Motor-Powered Aircraft (CMPA) and licensed air carrier aircraft.
Part-CAO	Part-CAO defines the requirement to be complied by a Combined Airworthiness Organization (CAO) to be able to get the approval and maintain that approval to perform maintenance and continuing airworthiness management of an aircraft. The scope of this part is applied to aircraft not classified as CMPA or listed in the air operator certificate of a licensed air carrier.

Likewise defined for Part-M, each of the described parts are composed by to 2 sections, where first part is addressed to technical requirements while second section is about procedures for competent authorities.

The following figure 10 resumes the scope where each part can be applied. Note that in this context, “Commercial Air Transport” means “aircraft operation to transport passengers, cargo or mail for remuneration or other valuable consideration”.

<table>
<tr><th colspan="2" rowspan="3"></th><th colspan="5">Non-licenced air carrier</th><th colspan="2">Licenced air carrier</th></tr>
<tr><th colspan="3">Non-commercial</th><th colspan="2">Commercial[2]</th><th rowspan="2">Non-CMPA</th><th rowspan="2">CMPA</th></tr>
<tr><th colspan="2">Non-CMPA</th><th rowspan="2">CMPA</th><th colspan="2">Non-CMPA</th></tr>
<tr><th colspan="2"></th><th>‘Light’[4]</th><th>Non-‘Light’</th><th>‘Light’</th><th>Non-‘Light’</th><th>Non-CMPA</th><th>CMPA</th></tr>
<tr><td colspan="2">Part-M (Annex I)</td><td>N/A</td><td colspan="2">Part-M mandatory</td><td>N/A</td><td colspan="2">Part-M mandatory</td><td colspan="2"></td></tr>
<tr><td colspan="2">Part-ML (Annex Vb)</td><td>Part-ML mandatory</td><td colspan="2">N/A</td><td>Part-ML mandatory</td><td colspan="2">N/A</td><td colspan="2"></td></tr>
<tr><td colspan="2">Part-CAMO (Annex Vc)</td><td rowspan="2">Individual CAM[5] or CAO-CAM or CAMO</td><td colspan="2">Part-CAMO mandatory</td><td rowspan="2">CAO-CAM[6] or CAMO</td><td colspan="2">Part-CAMO mandatory</td><td colspan="2"></td></tr>
<tr><td rowspan="2">Part-CAO (Annex Vd)</td><td>for CA management (CAO-CAM)</td><td colspan="2">N/A</td><td colspan="2">N/A</td><td colspan="2"></td></tr>
<tr><td>for maintenance (CAO-M)</td><td rowspan="2">Individual maintenance[7] or CAO-M[8] or Part-145</td><td colspan="2">N/A</td><td rowspan="2">CAO-M or Part-145</td><td colspan="2">N/A</td><td colspan="2"></td></tr>
<tr><td colspan="2">Part-145 (Annex II)</td><td colspan="2">Part-145 mandatory</td><td colspan="2">Part-145 mandatory</td><td colspan="2"></td></tr>
</table>

[1] Air carrier licensed in accordance with Regulation (EC) No 1008/2008.

[2] Commercial = balloon operated under Subpart-ADD of Part-BOP or sailplane operated under Subpart-DEC of Part-SAO or other aircraft, not operated under Part-NCO; includes commercial ATO and comm DTO.

[3] CMPA = Complex motor-powered aircraft, ref. Article 3(j) of Regulation (EC) No 216/2008.

[4] ‘Light’ a/c (not formal denomination) = Aeroplanes up to 2 730 kg MTOM, rotorcraft up to 1 200 kg MTOM / max 4 occupants, and other ELA2 aircraft.

[5] Individual CAM (not formal denomination) = continuing airworthiness of the a/c managed by the owner under its own responsibility.

[6] CAO-CAM (not formal denomination) = Part-CAO organisation with continuing airworthiness management privilege.

[7] Individual maintenance (not formal denomination) = maintenance released by pilot-owner or independent certifying staff.

[8] CAO-M (not formal denomination) = Part-CAO organisation with maintenance privilege.

Figure 10 - Continuing airworthiness requirements and approvals required (EASA 2021b)

In the following chapter it will be described the Part-CAMO that is the base to the CAMO requirements and is within the scope of tis work. As described in table 6, Part-CAMO is related with Part-M. This means that Part-CAMO requires the compliance of specific Part-M requirements, so being some tasks to be performed are within the scope of this part.

3.2.3. Part-CAMO structure and responsibilities

The objective of this subchapter is to describe in more detail the structure and principal definitions of the Part-CAMO requirements. A more faithful analysis of each requirement will be done in the analytical phase of this thesis.

EASA defines Continuing Airworthiness as "all of the processes ensuring that, at any time in its operating life, the aircraft complies with the airworthiness requirements in force and is in a condition for safe operation" which is very similar with ICAO definition on §3.2.1.1. EASA also defines Organization as the "natural person, a legal person or part of a legal person […]" that "may be established at more than one location whether or not within the territory of the Member States" (EASA 2021b). Therefore, a CAMO can be defined as an authorized Organization which may be a natural person, a legal person or part of a legal person to perform and guarantee aircraft continuing airworthiness.

As described before Part-CAMO is composed by the Section A - "Organization Requirements" and by the Section B - "Authority requirements". The section B of this annex is addressed to National Authorities that must verify and guarantee the Organizations compliance, defining then the procedures to assure that. The scope of this work is related with the requirements that a CAMO must comply, hence is related with the requirements defined in section A. In this section are established the requirements to be met by the Organizations to obtain the required authorizations to manage the continuing airworthiness of the aircrafts within their scope. Thus, section A is divided on the following requirements:

Table 7 - Part-CAMO requirements general description (EASA 2021b)

Requirement	Description
CAMO.A.005 Scope	Defines the scope of this part, namely the fact that is applied to Organizations that want to perform continuing airworthiness activities as defined on the regulation.
CAMO.A.105 Competent Authority	This requirement defines which Competent Authority should be designated for the verification of the compliance of this annex.
CAMO.A.115 Application for an Organization certificate	Defines how the Organization shall apply for the initial or amendment recognition for its approval, namely through pre-audit for CAMO requirements, but also through a documental demonstration how the Organization comply with these requirements.
CAMO.A.120 Means of compliance	This requirement defines how an organization can use an alternative mean of compliance and how can demonstrate to the Competent Authority the full requirements compliance.
CAMO.A.125 Terms of approval and privileges	This requirement defines the CAMO responsibilities scope after getting approval to perform Continuing Airworthiness tasks, namely: ▪ Managing the aircraft continuing airworthiness within Organization scope.

	▪ Manage subcontracted Organizations to perform limited continuing airworthiness tasks under its management system. ▪ Extend airworthiness review certificates as authorized. ▪ Approve the Aircraft Maintenance Program as authorized.
CAMO.A.130 Changes to the Organization	This requirement defines which changes shall be endorsed to authorities to prior approval, namely changes in the approval scope, to the key functions personal nominated and changes to procedures that define not requiring prior approval changes.
CAMO.A.135 Continued validity	This requirement defines the conditions to maintain the validity of CAMO approval in order not to be terminated, suspended or revoked.
CAMO.A.140 Access	This requirement defines the obligation of the Organizations giving access to any "facility, aircraft, document, records, data, procedures or any other material relevant to its activity subject to certification" to the Competent Authority or a delegated third party nominated by that authority.
CAMO.A.150 Findings	It defines that an Organization shall identify the root causes after being notified of any finding about any non-compliance. Shall also develop and implement a corrective action plan demonstrating its effectiveness.
CAMO.A.155 Immediate reaction to a safety problem	This requirement defines that a CAMO Organization shall implement any safety measure or information issued by the authorities or by the agency.
CAMO.A.160 Occurrence Reporting	It defines that an Organization shall have implemented an Occurrence Reporting system for any occurred issue (incident, accident, defects, technical limitations, etc.). These reports shall be made to the competent authorities until the following 72 hours after the issue finding.
CAMO.A.200 Management system	This requirement derives from ICAO Annex 19 - Safety Management as defined in 3.2.1.2. It requires that a CAMO shall establish, implement and maintain a system where responsibilities and the policy consider safety issues; the risks and hazards are identified in the activities developed and mitigation actions are taken; all key processes are documented; and all the personnel as the required training and competence.
CAMO.A.202 Internal safety reporting scheme	This requirement completes de CAMO.A.200 requirement by requesting an internal safety reporting process to evaluate internal reports about error, hazards and findings in order to be evaluated and actions could then be taken and feedback given.
CAMO.A.205 Contracting and subcontracting	This requirement defines that a CAMO shall guarantee the contacting maintenance activities or subcontracting airworthiness management

	activities complies with the established requirements and that safety hazards are identified within the Safety Management System.
CAMO.A.215 Facilities	This requirement defines that the Organization shall establish the right accommodations at the right location so that management activities can be performed.
CAMO.A.220 Record-keeping	The CAMO shall guarantee that aircraft continuing record system is retained and maintained. These records are composed by aircraft technical data, namely: total in-service life accumulated of aircrafts, engines and/or propeller(s); maintenance records; the aircraft technical log; mass and balance reports; airworthiness directives; modifications and repairs; other technical data from the required components and other data necessary to guarantee the aircrafts airworthiness. The Organization shall also keep records from the airworthiness review certification or recommendation issued if it has approval for that task. It shall be also maintained the subcontracting and contracted records and the personnel records.
CAMO.A.300 Continuing airworthiness management exposition (CAME)	This requirement establishes that each CAMO shall have a document statement where identifies the commitment to comply the Part-CAMO requirements, the safety policy, but also identify the key personnel, their responsibilities, the Organizational structure, the main processes to comply with all the requirements, the scope of the certification and the list of the approved aircraft maintenance programme.
CAMO.A.305 Personnel requirements	This requirement defines the key functions and competences that the key personal shall have to manage the top responsibilities in a CAMO. The key personnel are the accountable manager, the person or group of persons responsible ensuring that the Organization always complies with continuing airworthiness requirements, a person or group of persons responsible to manage the compliance monitoring and a person or group of persons responsible to manage the SMS.
CAMO.A.310 Airworthiness review staff qualifications	If the Organization has the privilege to issue permit to fly through the emission of the airworthiness review certificates, this requirement defines the qualifications needed to perform this evaluation and perform this review.
CAMO.A.315 Continuing airworthiness management	This requirement defines the following CAMO main responsibilities: ▪ To guarantee that Continuing airworthiness management tasks are carried out; ▪ For each aircraft, to manage the aircraft maintenance programme and the reliability program ensured that is performed and controlled; ▪ Ensure that the modifications and repairs are controlled and developed in accordance with the technical data;

	▪ Guarantee that maintenance is carried out in approved maintenance Organizations.
CAMO.A.320 Airworthiness review	This requirement establishes that any CAMO can perform the airworthiness review in accordance with the requirements if have conditions to perform that task and is approved in conformity.
CAMO.A.325 Continuing airworthiness management data	This requirement defines that CAMO shall hold and use applicable maintenance data from recognized entities. This data can be provided by the aircraft owner or operator. The data from this requirement are requirements, procedures standards or information issued by the authority by the agency; an applicable Airworthiness directive; an instruction issued by the type certificates holder, supplementary Type Certificate Holders or an authorized Organization certified in accordance with Regulation (EU) No 748/2012 Part-21 that includes the Design Organization Approval (DOA) requirements.

Throughout Part-CAMO document there are some requirements that required the compliance of specific requirements of annex I (Part-M) or annex Vb (Part-ML). This is due the fact that these parts defines with more detail the continuing airworthiness tasks to be performed which complete the Part-CAMO responsibilities (EASA 2021b). In this thesis scope, it only will be considered Part-M requirements once it can be applied in a transversal way independent of the aircraft requirements. Complying with Part-M requirements will also allow to include Part-ML scope. Thus, Part-M subpart C - “Continuing Airworthiness requirements” from requirement M.A.301 to M.A.307 complete the CAMO.A.315 Continuing airworthiness management defining with higher detail the tasks that a CAMO must perform at operational level. This part defines that to guarantee that an aircraft is airworthy and serviceable to be operated, a CAMO shall establish the necessary processes that ensure:

- The pre-flight instructions are performed;
- That any defect or damage is rectified in accordance with approved documentation and approved data available, Minimum Equipment List (MEL) and the configuration deviation;
- That the maintenance is performed in accordance with the approved Aircraft Maintenance program;
- That an aircraft should be releases in accordance with specific release process and where all the responsible issue about that release;
- That any applicable directive (operational or airworthiness), requirement or measures defined by a Competent Authority is accomplished;
- The modifications or repairs are performed in accordance data approved by competent authorized entity;
- The mass and balance and maintenance check flights are made when required in accordance with the technical data.

The following figure resumes the main operational tasks to be performed by a CAMO:

Figure 11 - Task to be performed by a CAMO at operational level

The CAMO critical task that supports and defines all the other tasks to be performed is the Aircraft Maintenance Program (AMP) management. This AMP goal is to define and guarantee the update of the maintenance tasks required, their interval to be performed, and define the necessary support to be held. Is this document that is the first piece to ensure a safe operation within aircraft live. The purpose of this document is to prevent any failure of materials or of the system and have a predictive approach that allows to restore the adequate operation and performance of the aircraft and its systems. All the maintenance and tasks should be performed in conformity with this program (Monteiro n.d.).

Each of these requirements will be later analyzed in the discussion chapter. Is this analysis that will guide to the identification and proposal of the main processes of a CAMO.

3.3. AVIATION TECHNOLOGICAL ENABLERS

3.3.1. Industry 4.0 - Principal trends and practices on industry

When we begin to analyze which technological trends that are being followed in industry currently, the most discussed concept is industry 4.0. So being, the objective of this subchapter is to define industry 4.0 and the main technology enablers within it.

In 2011 the German govern presented the concept of industry 4.0 as the fourth Industrial revolution. After the first industrial revolution in the eighteenth century with the use of steam power; the second industrial revolution where mass production and electric energy was introduced in the manufacturing; and the third industrial revolution in the middle of twenty century with automation and microelectronic technology; industry 4.0 concept came to introduce new technologies like the Cyber-Physical Systems (CPS), Internet of Things (IoT) and cloud computing focusing in end-to-end digitization and the use of digital industrial systems in an integrated form (Xu, Xu and Li 2018). Industry

4.0 uses cognitive computing techniques, applies data science and analytical models to analyze real-time data from multiple machines, processes and systems that can provide an increase of the level of business automation. Industry 4.0 can be an enabler on advanced production, distribution, transportation, service, maintenance and manufacturing processes (Tao et al. 2016).

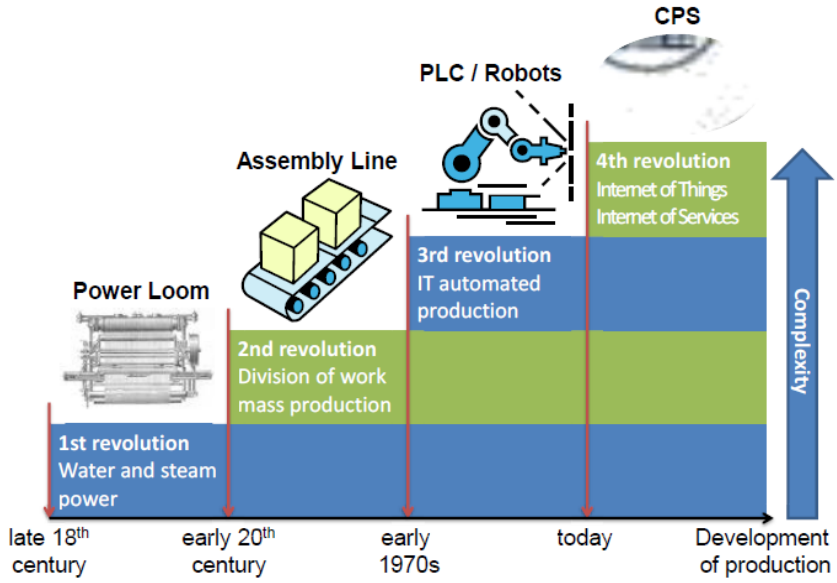


Figure 12 - The Industrial revolutions (Thoben, Wiesner and Wuest 2017)

Furthermore, recent trends came to introduce even more interactions between machines, humans and data. Introducing new technologies like Augmented Reality and Additive Manufacturing can provide improvement in productions times, allowing smart structures to be developed (Ceruti et al. 2019). These technologies require a proper system architecture once a high huge amount of data can be collected for different sources in real-time. This means that integration of big data should be also a new challenge to be held.

To get valuable information and knowledge from the collected data it can be used advanced data analytics. This include Data Mining and Machine Learning which may allow the transformation of the collected data into supporting valuable actions, like processes redefinition, rules, procedures improvements but also may provide a better base for decision-making (Cachada et al. 2018). Industry 4.0 can be resumed through three main factors:

- Smart Product where the product became a live part of the system with data and requirements stored directly as an individual building.
- Smart Machine with use of autonomous, intercommunication and intelligent systems and self-organized systems of CPS.
- Augmented Operator where workers can provide their full potential using technological support adopting key decisions roles and flexible problem-solving approach (Weyer et al. 2015).

The following table resumes the main technological enablers identified for industry 4.0:

Table 8 - Main technological enablers for industry 4.0

IoT and related technologies

The concept of IoT had been following the evolution of used technology. Van Kranenburg in 2008 defined IoT as “a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual ‘Things’ have identities, physical attributes and virtual personalities and use intelligent interfaces and are seamlessly integrated into the information network” (Van Kranenburg 2008). Xu et al. introduces a more recent definition of IoT as ”a global network infrastructure composed of numerous connected devices that rely on sensory, communication, networking and information processing technologies” (Xu et al. 2018). So being, IoT uses several different technologies to identify, track, monitor and control getting real time data from materials, objects, machines, humans or processes. It can use everything that interconnects systems and data through a network infrastructure like several type of sensors, Radio-Frequency-Identification (RFID), smartphones, cyber-physical systems (Xu et al. 2018).

Cloud computing

Cloud Computing can be defined as a set of internet-based computer services that follows existing technologies such as virtualization and grid computing. Microsoft (2019) defines cloud as “a vast network of remote servers around the world that are interconnected and that must function as a unique ecosystem”, having been “designed to store and manage data, run applications or deliver content or a service, such as streaming videos, webmail, office productivity software or the media”. The use of this technology also promotes the existence of new risks associated with the existing one in the past (Hassan et al. 2019). In accordance with Mell e Grance, Cloud computing is a model that allows access on demand in a convenient, ubiquitous and configurable way to a set of computational resources such as networks, servers, storage, applications and services. These resources can be quickly provisioned with the minimum management effort or interception with the service provider (Mell and Grance 2011). In resume, this technology allows the upload and access to a large volume of data, digital files, applications and other types of digital services from any location, at any time from any device with an internet or local connection, enabling modular and service-oriented in industry context where systems harmonization and service sharing are essential (Xu et al. 2018).

Cyber-Physical Systems (CPS)

According with some authors CPS is considered the core foundation of Industry 4.0, once these are systems that integrate and coordinate the software and physical components within deferential ways, as required within the context. CPS combines the virtual and physical world without boundaries that allows a collaborative approach between machines, software and humans, integrating computing, communications and storage capabilities. This results in a merge of technical and business processes that can lead to business productivity and efficiency in a flexible way which has been scaled by IoT (Xu et al. 2018). So being CPS are autonomous machines, storage systems or utilities able to collect data about the environment, exchange information, triggering actions and able to control the processes in production or in logistics themselves along the system life cycle. It can be seen as systems of systems combining various technical and organizational disciplines (Thoben et al. 2017).

Data Analytics

Data analysis affects all aspects of our contemporary daily life however the discipline and is assumed that is also an essential component in industry 4.0. Data analytics is the baseline that allows the connection between all the components of the system for the purpose of the business. It also allows the execution of the smart manufacturing or the smart maintenance. The data analytics is composed

by algorithms and methods that uses real-time data from different sources and processes. It supports human decisions and helps to automate machine behavior. The huge amount of data brings also new challenges about data security and data quality that should be taken in account on the construction of the system (Thoben et al. 2017). Data analytics can use different approaches like big data technology, Data Mining and also is directly related with artificial intelligence methods like deep learning or machine learning that can be an asset in algorithms approach.

Virtual Augmentation

This Augmented Reality (AR) concept was introduced in 1997. It can be defined as virtual computer image or graphic that supersedes the real image of the world. AR is considered a Virtual Reality (VR) evolution with the difference that has an interface with real world (unlike VR). AR uses computer aided design (CAD) models, symbols, letters, images, labels or a virtual object that are applied above the real-world image by the use of special AR glasses or mobile devices (Ceruti et al. 2019). AR uses a computer base positioning that interact with real world through a camera, which promote and interconnects the required information. It uses a procedure that starts with the image acquisition by the camera, the tracking in order to reference the position followed by the registration that synchronizes the virtual scenario with the real world and then the display of the real world with the virtual scenario imposed (Ceruti, Liverani and Bombardi 2017).

Additive Manufacturing

Additive manufacturing uses different techniques that transform raw material (solid or liquid) to create solid complex pieces using 3-D printing technology with different shapes and complex structures. These components can be adjusted to the form and characteristics required. It can have advantages of weight reductions, less energy required and quick development and production of specific pieces accordingly with the requirements to be complied. These techniques require high performance machines (Ceruti et al. 2019).

The use of Artificial Intelligence (AI) can bring advantages to industry 4.0. Accordingly with Lee et al. AI can be integrated with IoT, big data analytics, cloud computing and cyber physical systems to enable “operation of industries in a flexible, efficient and green way”. For that it is essential “to clearly define its structure, methodologies and challenges as a framework for its implementation in industry” (Lee et al. 2018). This bring enormous challenges, namely for Machine-to-Machine interactions, data quality and also for cybersecurity (EASA 2020a).

As described, industry 4.0 includes within its scope a change in the paradigm concepts of manufacturing and maintenance toward automation, the integration of physical and virtual world, data collection through a variety of sources (sensors, actuators and over internet) and the use of technological breakthroughs. The real-time data availability reduces waste, enhance dynamics business and engineering processes and can improve more valuable logistics systems with optimal value streams. It also can provide better predictive maintenance, improved design and better products production. The following figure schematize the industry 4.0 point of view:

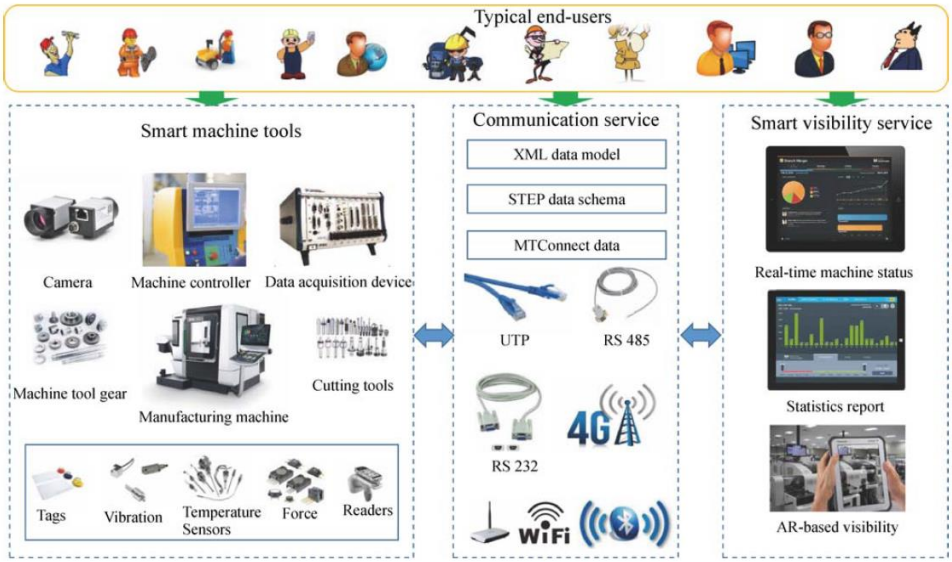


Figure 13 - Industry 4.0 CPS integration (Zheng et al. 2018)

The implementation of Industry 4.0 principles requires development actions in following areas: standardization through a reference architecture; implementation of a management model due to the systems complexity; a reliable and bast broadband communication system for IoT; a safety and security system approach in order to avoid harmful situations; high level of work and processes organization; a continuous qualifying and training of workers; a regulatory framework with privacy and liability regulations for this new kind of approach; and resource efficiency in other to reduced wastes in energy and raw material (Thoben et al. 2017).

3.3.2. Application of technology on aviation industry

Although aviation industry appears to have a slow reaction approach to the adoption of new technologies, the enablers identified in the previous chapter could become breakthroughs influencing all the aviation industry domains and the way people and goods travel. Technology will have an impact in the way the businesses relate with each other, in the supply chain logistics, and in the relations with the costumers (IATA 2018). The objective of this subchapter is to give some examples found on the literature of how technology is being or can be applied in the aviation sector, namely in activities that can be related with continuous airworthiness. Within this purpose it will be considered the technologies identified through the industry 4.0 discussed previously.

The application of industry 4.0 implies a paradigm change and may enable great improvements within aviation industry. Valdes and Gómez use a specific term for this concept - Aviation 4.0. For these authors one of the major drivers that can change aviation industry is the use of IoT integrated with CPS systems. These technologies will allow to transform aircraft in smart aircraft allowing to collect real-time data to support operations but also to support predictive maintenance through maintenance messages, fault codes, flight and systems parameters that support decision making. CPS would be an essential asset to support humans, completing autonomous tasks and supporting decisions and improving safety issues (Valdes and Gómez 2018).

The real time collection of aircraft data will allow aircraft constructors, airworthiness managers and maintenance managers to have more detailed comprehension of the aircraft's behavior. This would promote more effectiveness design of maintenance programs, which lead to safer operations and less expensive costs during systems life cycle management. Moreover, there is a potential of exploration combining the predictive maintenance with synchronized logistics through optimized data analytics algorithms. This will lead to improve turnaround times, with shorter maintenance interventions (Valdes and Gómez 2018). Within this purpose the European Commission describes that with industry 4.0 in aviation and "the development of preventive maintenance services will help reduce aircraft downtime and increase the safety of the industry". This will increase effectiveness of the companies once an "aircraft on ground time is a critical cost factor for the airline industry" and a "cause major disruption and damage an airline's reputation" (European Commission 2017).

The use of IoT enables to have smart approach that support aeronautics manufacturing and maintenance. IoT can provide the connection between technicians, tools and materials. This means that a specific task can be fully documented with the use of a smart device (smart glasses, smartphone or tablet), where can be identified which task to accomplish, the materials needed, the specifications and the required tool to perform that task. It will also allow to identify the material and tool's location in real time. In addition, this technology can allow to track if the worker has the required qualifications or authorizations to perform that kind of work (European Commission 2017). With this purpose, the use of IoT combined with the Augmented Reality combined with IoT will offer a myriad of solutions. This technology will allow each technician to directly obtain access to maintenance manuals or illustrated part catalogues or virtual "always update" procedures to perform the required task. It will also provide different ways for technician to obtain training and qualifications. This interaction will also enable to have a better information flow between technicians, the engineering and continuous management responsible once the defect is identified, the same information and better documented could be available in real time for all the stakeholders as required (Ceruti et al. 2019).

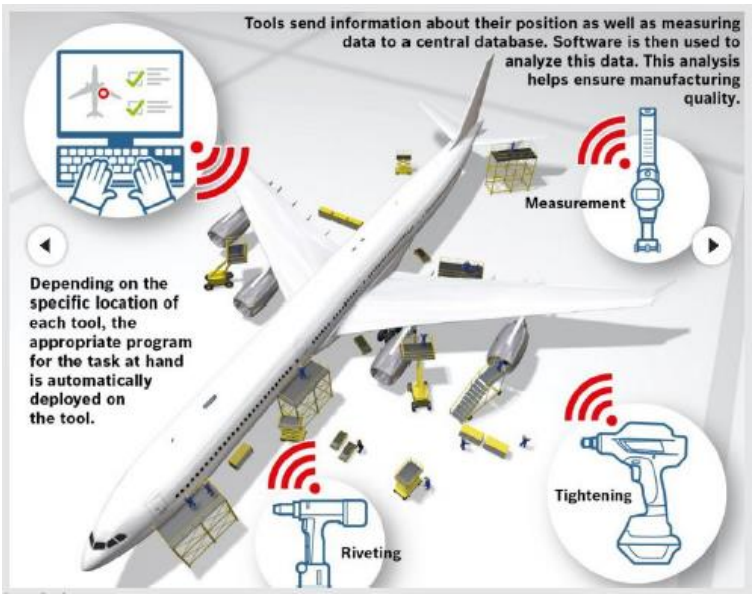


Figure 14 - Tracking tools scheme (European Commission 2017)

With the use of augmented reality technologies, the maintenance technicians have the possibility of having all the necessary information to solve any problem in a faster and effectiveness way. This capability will lead to the decrease of maintenance errors and accidents probability improving efficiency and reduce costs (Valdes and Gómez 2018).

IoT, CPS and cloud technology can also enable the digitalization of aircraft logbook. The aircraft logbook is a document where all the routine task, date and time inspections and general condition are daily recorded. This document has essential data for a CAMO as identified in paragraph 3.2.3. The digitalization of this log integrates essential data to maintain the aircraft airworthy. This data can include the MEL, the technician's maintenance data, the systems data or the pilot operational report. Using specific databases with cloud computing support, IoT and an oriented service it would be possible to decrease latency, increasing information availability and quick dissemination contributing for safer operations (Haruzly, Abd Hakim, I.F.S and Ishak 2019).

Other technology that can be a new disruption in the aviation sector is the additive manufacturing. One application is the replacement of some spare parts by additive manufacturing machines and powders that allows the self-production, which could optimize components in terms of weight and structural stress. This will have direct impact in shortening supply chain and reduced maintenance time waiting for spares (Ceruti et al. 2019).

According with EASA AI is "any technology that appears to emulate the performance of a human" that is "coming with a fast pace and being adopted widely, including in the aviation domain" (EASA 2020a). This led EASA to publish an artificial Intelligence Roadmap, that identifies, among others "the key opportunities and challenges created by the introduction of AI in aviation" (EASA 2020a). This document identifies the use of machine learning and deep learning as a current breakthrough. Machine learning provide the use of data train algorithms that could improve their performance, while deep learning uses deeper neural networks that can provide learning capability and enables applications like computer vision and natural language processing (EASA 2020a). EASA identifies, aircraft design and operation, aircraft production and maintenance, air traffic management, drones, urban air mobility and u-space, safety Risk Management, cybersecurity, environment and EU regulations like the main areas where AI can be applied. In CAMO scope, predictive maintenance algorithms can anticipate failures and provide preventive corrective actions promoting a paradigm shift. The use of data science combine with statistics, mathematics, intelligent data capture techniques, data cleansing, mining and programming can provide the identification of emerging risks, vulnerabilities or anomalies, their prioritization and identify optimized solutions (EASA 2020a).

The implementation of industry 4.0 on aviation provides a general transformation on the processes with impact on production, in the value chain, bringing new services offering and new business models opportunities. The Organizations shall be prepared and be capable to adapt for digital transformation. To achieve that, they should evaluate different architectures adapted to the available technology, prepare their employees with the required qualifications, design more costumer focus processes, with new services, new mechanisms, investments and promoting continuous improvement (European Commission 2017).

4. CAMO REGULATION ANALYSIS

4.1. CAMO PROCESSES LEVEL 1 DISCOVERY

The first step required with the CAMO regulation analysis is to enable the identification of the possible high-level processes needed for a CAMO. To proceed to the discovery of these processes, two categories were created to help identify the scope of the requirements that a CAMO must comply. The first category had the objective to classify if the requirements evaluated are eligible to be part of the process, information architecture or both. There are also requirements that were classified as general, which means that are transversal requirements without a specific task or document where it should be applied. Typically, are general considerations or determinations eligible to be part of the organization's general operation or policy but don't require a physical task to be accomplished. Hence, the following 3 types of requirements classification were taken:

- Process/task requirements - Requirements that defines the fulfilment and accomplishment of a task.
- Documental/Record requirements - Requirements that defines the use of a specific or a general document or the need to show a specific requirement record fulfilment to show as accomplishment evidence.
- General requirements - General requirements to fulfil over the organization, that is not specific Process/task or Documental/Record requirement.

The second category that was considered had the objective to organize the requirements classified as process/tasks in process structure accordingly with Porter's value chain model (Hull, Mendling and Tai 2018). According to this model processes can be organized as:

- Management Processes - Identifies processes and tasks that provide directions, rules to fulfil the organization goals.
- Core Processes - Identifies processes and tasks that generate value to the organization and to the clients.
- Support Processes - Identifies process that provide resources needed to be used in the other processes.

To classify CAMO requirements the following procedure was taken. First activity was to identify the processual requirements and overall requirements. This included requirement analyses of the hard law, but also the soft law AMC requirements and specified Guidance Material requirements overview. Then these requirements were classified accordingly with process/task, documental/record or general classification. Afterwards, the Process/Task requirements were evaluated and classified accordingly with their scope within Porter's value chain model. This classification allowed the development of the appendix table 44. This table establish a cross check between the requirements and their classification in the identified categories which provide a clearer visualization of the regulation requirement type.

Flowing down in a more specific architecture and after analyzing each process requirement, a more restrict process classification was made. The CAMO principal mission is to maintain the aircraft airworthy, which means to be fit to fly within a determined safety level condition according with the

defined requirement. From the requirements it can be discussed that at management level, tasks can be divided into task where compliance is evaluated and other where policy, structure, actions and goals are defined to achieve the determine organizational and safety objectives.

At operational level, a CAMO must guarantee aircraft airworthiness through three different areas. It must control the aircraft operation, namely the maintenance needed to be performed and check if there are any issue to be resolved after each flight. In a second level, CAMO must define and guarantee that aircraft maintenance program is accomplished, maintained, updated and that any instruction or directive issued by a recognized entity is applied as required. The last CAMO responsibility to maintain any aircraft airworthy is to guarantee that Airworthiness Review is performed in a periodic basis as required.

To guarantee CAMO functions three support areas can be discussed based on requirements. Human Resources, Facilities and Procurement Management. Human Resource (HR) Management emerge due to the different personnel requirements that CAMO must ensure that are met. Facilities management is a simple but necessarily need to be accomplished having a specific requirement to comply. Procurement is a support level where CAMO must guarantee that any contracted or subcontracted services or products complies with established requirements. In particularly, specific requirements must by complied when a maintenance service must be contracted or a CAMO task must be subcontracted.

With this deeper analysis and after some iterations during the evaluation process, these specified areas led to consider them has general top processes. Each process scope was then considered according with the following definitions:

- Management processes
  - Strategic Management - Top process that includes all the activities that establish the orientation of the CAMO, in terms of goals to be achieved, the Organizational sectorial plans and responsibilities through the structure. This process includes the Risk Management and safety policies to implement, and the continuous improvement policy defined in the SMS pillars.
  - Compliance Management - Top process that includes all the necessary actions to check if the necessary requirements are being met by the organization as also all the necessary tasks to promote the necessary issues report, the evaluation of findings causes and the definition of all the necessary actions to eliminate the cause of that findings.
- Operational Processes
  - Aircraft Management - Top process that includes the necessary actions to control the operation and maintenance of the aircraft, including the Pre-Flight Inspection and the issue of the permit to flight as required.
  - Airworthiness Data Management - Top process containing all the necessary tasks to control the applicable maintenance data to be applied to the CAMO scope, but also to define and control the maintenance tasks to be performed in the aircraft

and components. Includes the task to ensure the AMP Management and its continuous improvement.

- Support Processes
  - Human Resources Management - Top process that includes all the task to guarantee the necessary qualifications, training, evaluation and quantity of the Human Resources required. It must include the Safety promotion requirements accomplishment.
  - Facility Management - Top Process that includes all tasks related with maintaining facilities, according to the requirements, so that operational processes may be accomplished.
  - Procurement Management - Top Process that includes the necessary tasks to find, contract or subcontract the service and product providers that must comply with the defined requirements to accomplish CAMO mission.

During requirement analyses it was possible to identify the typical stakeholders involved in these processes. These entities can be directly or indirectly identified in the requirements as followed:

Table 9 - Stakeholders identification

Stakeholder	Type	Observations	Requirement
Maintenance Repair Organization (MRO)	Service Provider	Must comply with Part-145 or Part-CAO requirements. May be part of CAMO organization.	CAMO.A.205 CAMO.A.304 CAMO.A.315 M.A.301 M.A.305
Competent Authority	Partner/Supplier	Establish CAMO requirements, may issue instructions or directives and is responsible to oversee CAMO compliance. It can be requested some verification, certificates reviews document and personal approvals.	CAMO.A.130 CAMO.A.140 CAMO.A.115 CAMO.A.300
Type Certificate Post Holder	Partner/Supplier	Can issue some directives and can be contracted to technical support in terms of technical data and resolve any unforeseen issue detected. On the scope of processes design includes the supplementary Type Certificate Holder as applicable.	CAMO.A.160 CAMO.A.215 CAMO.A.220 M.A.304
DOA	Supplier	Must comply with Regulation (EU) No 748/2012 Part-21 requirements and can be contracted to technical support. It	CAMO.A.125 CAMO.A.215

Stakeholder	Type	Observations	Requirement
		may also be part of CAMO organizational company.	M.A.304 M.A.305
General Product/Service provider	Supplier	Any company contracted to provide a required product or service (excluding MRO service or CAMO subcontracting) as for example facility issues.	CAMO.A.205
Authorized CAMO	Supplier	A CAMO with specific privileges subcontracted to perform some tasks not allowed by the present CAMO.	CAMO.A.125 CAMO.A.202 CAMO.A.205
CAMO owner	Owner	The CAMO Owner represent the stakeholder interested in the business organizational results in accomplishment with the defined requirements.	CAMO.A.200
CAMO	Client/Supplier	CAMO represents all the CAMO needs, processes as general term and collaborates that receive or gives information necessary to maintain the Organizational compliance and full operation.	CAMO.A.200 CAMO.A.202
Aircraft Owner/ Air Operator	Client	Entity or organization that owns the aircraft and was responsible to contract an organization to operate the aircraft and contracted the CAMO service to guarantee its airworthiness. In this scope was included the aircraft operator organization or operational area (if CAMO belongs to the same operator organization).	CAMO.A.315 M.A.301
AW Review Client	Client	Other Part CAMO, Part CAO or part ML can subcontract CAMO to develop specific tasks. In this scope were considered only the AW Review tasks.	CAMO.A.125 M.A.901

Once all the requirements are safety focus and with the airworthy aircraft identified as the CAMO final product it's possible to establish figure 15 scheme. In this figure it's possible to overview the integration of CAMO processes scope with the identified client/owner and with supplier/partner. This scheme resumes a first view of the top vision processes identification approach:

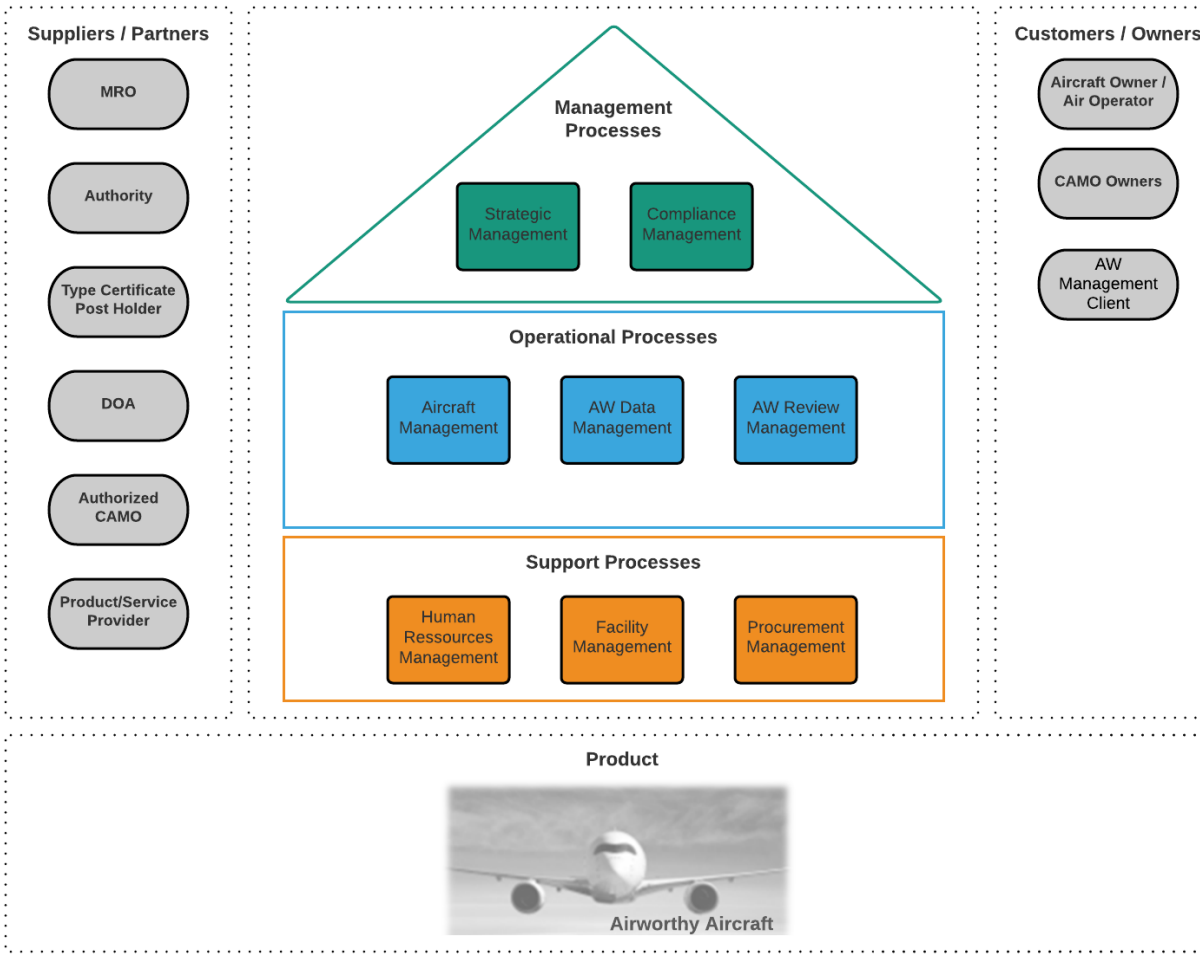


Figure 15 - Top management processes scheme

This approach enabled the identification and proposal of CAMO high-level processes. However, each requirement evaluated may have a more general or specific scope. Sometimes requirements have a more specific scope and identify specific tasks to be performed. In these cases, it's possible to proceed into a more detailed evaluation that enables to define more precise CAMO responsibilities boundaries. This evaluation leads to proceed to a second level of processes, as follows.

4.2. CAMO PROCESSES LEVEL 2 DISCOVERY

In order to have a clearer identification of the CAMO areas of actuation, and with the regulation requirements as base, the next step is to identify the second level of CAMO processes. For this task it was reused and completed the appendix table 44. For each CAMO requirement it was identified specific function areas to be performed that fit in the requirement scope. This was developed to all process/task and documental requirement identified in the paragraph 4.1. and were included all CAMO tasks that are identified in figure 11. This analysis led to CAMO process level 2 identification proposal that can be resumed in the following table:

Table 10 - Level 2 process identification

Process level 1	Process level 2	Scope	Requirement
Strategic Management	Documental Management	Process that includes the documental approval by the appropriate organization level defined on the manual that includes Authority final approval if required	**CAMO.A.115 CAMO.A.120 CAMO.A.130 CAMO.A.220 CAMO.A.300**
	Risk Management	Process that includes the necessary activities to develop the necessary Risk Management actions applied to the organization, supplier or client as required. It's a necessary process of Safety Management System.	**CAMO.A.200**
	System Monitoring	Process that meets the requirements where are established the need to analyze the organization performance and define the organization goals (including safety goals), which includes the several sectors' reports, evaluations and actions definition.	**CAMO.A.200**
Compliance Management	Audit Management	Necessary process that includes the systematic periodic organizational compliance check with CAMO and defined requirements established.	**CAMO.A.200**
	Findings Management	Set of required activities to identify findings root causes, define actions and corrective actions to eliminate these causes.	**CAMO.A.150 CAMO.A.155 CAMO.A.200 CAMO.A.202 CAMO.A.315 M.A.301**
	Internal Reporting	Identified process to promote the internal report of safety, noncompliance, or airworthiness improvement issues. This is a SMS essential process.	**CAMO.A.202**
	Internal Investigation	Process that established the necessary tasks to develop a deeper investigation level with an independent investigation team which allows to evaluate occurrences causes and reported safety issues.	**CAMO.A.200 CAMO.A.202**
	Occurrence Reporting	Process that establishes the timings and tasks to report occurrences to authority.	**CAMO.A.160**
Aircraft Management	Operation Control	Process that controls the aircraft life limit consumptions during the operation, aircraft records, maintenance required and evaluates possible deferments.	**CAMO.A.220 CAMO.A.315 M.A.301 M.A.305 M.A.306**

Process level 1	Process level 2	Scope	Requirement
	Pre-Flight Inspection	Process that includes the necessary activities and final check to verify if the aircraft is airworthy. Includes the activities to report necessary maintenance if required.	**CAMO.A.220 CAMO.A.315 M.A.301**
	Maintenance Control	Control process that ensures the accomplishment of the necessary maintenance on the aircrafts. Includes the verification and record update as necessary of the maintenance documental system. This process also includes the control of all the airworthiness task to be performed: AMP tasks; Mass and Balance; AD accomplishment; Defects and repairs; Modifications. This process includes deferment analyses.	**CAMO.A.220 CAMO.A.315 M.A.301 M.A.304 M.A.305 M.A.306**
	Maintenance Planning	Periodic process to evaluate the required maintenance tasks to be perform during a specific maintenance cycle.	**CAMO.A.220 CAMO.A.315**
	Permit to Fly Issuance	Process that defines the necessary tasks to issue the permit to fly (if CAMO has that privileges) or to request a permit to fly to the Competent Authority. The permit to fly only can be issued if specific conditions are met.	**CAMO.A.125 CAMO.A.220**
AW Data Management	Data Management	Process that includes the applicability assessment of the technical data issued by the Type Certificate Post Holder or the Competent Authority and distribution for the required stakeholders and related processes where aircraft data updates is required.	**CAMO.A.220 CAMO.A.315 M.A.304**
	Reliability Management	Set of necessary tasks to systematic check if components or the aircraft complies with the necessary and established AMP in an effectiveness way. The process must be complied in accordance with defined program and produce information that can promote the AMP update.	**CAMO.A.315**
	AMP Management	Necessary tasks to continuous update and improve the AMP to guarantee its efficiency and effectiveness according with the safety standards.	**CAMO.A.125 CAMO.A.220 M.A.302**
	Directives Management	Continuous process to evaluate directives, instructions or other specific technical document to be applied in a specified aircraft.	**CAMO.A.315 M.A.301 M.A.303 M.A.305**
	Configuration Management	Process that establishes and define the configuration rules required for each aircraft, since components possible to be installed, life limit counters, MEL required to the aircraft be airworthy and Mission Equipment list of the aircraft.	**CAMO.A.220 CAMO.A.315 M.A.301 M.A.305**
	Aircraft AW transfer	Process with the necessary tasks to guarantee the airworthiness of an aircraft when the aircraft is	**CAMO.A.220 M.A.307**

Process level 1	Process level 2	Scope	Requirement
		received for the first time in a specific CAMO. Includes different tasks to be performed depending on whether the aircraft comes from EU or outside the EU.	**M.A.903** **M.A.904**
AW Review Management	AW Review Evaluation	Cycle process to evaluate aircraft. This process includes the airworthiness review certificate issue coordination, recommendation or extension as required according with CAMO privileges approval.	**CAMO.A.125** **CAMO.A.220** **M.A.901**
	AW Review Issuance	Necessary tasks to be developed to CAMO issue the airworthiness review certificate or recommendation.	**CAMO.A.125** **CAMO.A.220** **M.A.901**
Human Resources Management	HR Planning	Process that contains the necessary tasks to plan the Human Resources needed to perform the CAMO tasks in terms of quantity and requirements to be complied.	**CAMO.A.200** **CAMO.A.305** **CAMO.A.310** **CAMO.A.320**
	HR Recruitment	This process includes the tasks to be performed during the personnel recruitment. Includes the requirement check and, if necessary, the required training coordination.	**CAMO.A.130** **CAMO.A.200** **CAMO.A.220** **CAMO.A.305** **CAMO.A.310** **CAMO.A.320**
	HR Qualification Control	Continuous process that controls human resources requirements to be maintain for the required functions. Includes the training coordination as necessary.	**CAMO.A.200** **CAMO.A.220** **CAMO.A.310** **CAMO.A.320**
Facility Management	Facility Planning Control	Cycle process to guarantee the facilities requirements continuous accomplishment.	**CAMO.A.215**
	Facility Report	Established process that allows collaborators report any issue facility related. Includes immediate actions to be taken.	**CAMO.A.215**
Procurement Management	Contracting/ Subcontracting	Essential process to procure and contract or subcontract services/products providers. This process includes general possible procurement assessments.	**CAMO.A.125** **CAMO.A.315**
	Service/ Product Provider Control	Process that determinate the activities to check if contracted service/product complies with the requirements. Includes service/product evaluation tasks.	**CAMO.A.205** **CAMO.A.220**

After the identification of the second level processes, it was considered that the information provided by the requirements, but also by the AMC and GM provides the necessary guidance to develop a level 3 level of detail where each process identified can be designed in end-to-end approach. To accomplish this, it was necessary to proceed to the identification of the level 3 functional level identification as follows.

4.3. CAMO PROCESSES LEVEL 3 DISCOVERY

To proceed to design of CAMO processes a higher detailed analysis must be developed. In addition to the requirements establishment in the identified processes in the previous chapter, it's necessary to identify the organizational functions required in a CAMO. Part-CAMO doesn't define any specific organizational structure. However, it specifies some responsibilities and functions that must be held by someone on the organization. Table 11 resumes the CAMO function requirements specifications and describes the organizational functional level considerer during the design of the processes:

Table 11 - CAMO responsibilities versus BPMN functional level

CAMO Specification	General responsibility	Requirement	Functional level
Safety Review Board	The Safety Review Board is a high-level committee that supports accountable managers in strategic matters, namely policy, objectives, organizational effectiveness and performance, actions and compliance monitorization. Shall be composed by CAMO top structure as internally specified.	CAMO.A.200(a)(1)	Management level
Safety Action Group	The Safety Action Group is a support group that can be established to act on behalf the safety manager as required. This group is normally formed when the organization is complex and typically reports to high management level and can be composed by managers, supervisors and operational areas staff.	CAMO.A.200(a)(1)	Safety level
Accountable Manager	The accountable manager is responsible to ensure that all continuing airworthiness management activities have the necessary resources and are carried out in accordance with CAMO Regulation, delegating as required in the CAMO structural functions. It's responsible to establish and promote the CAMO safety policy.	CAMO.A.305(a)	Management level
Airworthiness Responsible	The airworthiness responsible is a person or group of persons that shall guarantee that the organization complies and develop the continuing airworthiness management activities in agree with the specified CAMO privileges.	CAMO.A.305(a)(3)	Airworthiness level
Compliance Responsible	The Compliance Responsible is a person or group of persons with the responsibility of	CAMO.A.305(a)(4)	Compliance level

CAMO Specification	General responsibility	Requirement	Functional level
	managing the compliance monitoring system processes. In case of CAMO is approved as air carried licensed a person shall be nominated and shall not be employed by a Part-145 Organization (unless in agreed with the Competent Authority).		
Safety Responsible	Th Safety Responsible is a person or group of persons with responsible to manage, maintain and improve the safety management processes of the management system.	CAMO.A.305(a)(5)	Safety level
Airworthiness Review Staff	The Airworthiness Review Staff is the personnel with the necessary qualifications and authorized by the Competent Authority to develop the airworthiness review process and issue the airworthiness review certificate.	CAMO.A.305(2) CAMO.A.310(a) CAMO.A.310(c)	Airworthiness Review Staff level
Permit to Fly Staff	The Permit to Fly staff is the authorized personnel to perform the Permit to Fly Issuance. To have this permission they must comply with Airworthiness Review staff qualification requirements and must be authorized to perform the airworthiness review process as well.	CAMO.A.305(2) CAMO.A.310(a) CAMO.A.310(c)	Permit to Fly Staff level
Pre-Flight Inspection Personnel	Pre-Flight Inspection personnel are the staff that have received appropriate training for the relevant Pre-Flight Inspection tasks according with the CAME definition that must be demonstrated to the Competent Authority.	M. A.301(a)	Pre-Flight level

The organizational responsibilities descripted on table 11 are the main responsibilities defined on Part-CAMO requirements, which lead to define the high-level function on process design. If in the future its needed to develop a more detailed architecture, it will also be necessary to detail specific functions. However, this will depend how each CAMO organizational structure is established. Once the requirements don't have further detail function established, each CAMO may define how is organized as long as they keep the baseline required as described on table 11.

Nevertheless, during the requirements evaluations were identified Part-CAMO tasks that don't fit on the specified functions identified on table 11. So being, it was necessary to establish and consider general functions with the responsibility to perform those tasks, which was essential to the development of third level design. Once again, if a more detailed structure is necessary to be developed, this function can be flow down to have a more specific function detail according with the

specific CAMO structure. Thus, the following table was elaborated to resume the identified functions within this context:

Table 12 - Considered functions levels not defined in CAMO requirements

Functional level	Description
Operational level	General function level that describes any functional area of the CAMO that have a specific activity to perform. This function is used when all the areas shall perform that activity.
Approval level	General function level that specifies the responsibility of the approval of a specified document. This function is used as generic once it will depend on structural functions and responsibilities defined on the CAME. Different areas could have distinct approval level actions depending on the type of documental to be approved.
Audit Team Level	Specific function that shall be taken by the audit team nominated to perform the audit. This shall be held by personnel with auditor qualifications.
Reporting Level	General level that defines the general reporting responsibility to all CAMO personnel. This a level than anyone in the CAMO shall have and perform as required.
Investigation level	Specific function that shall be carried out by the investigation team nominated to perform to perform the investigation of any identified issue. This shall be held by personnel with investigator qualifications.
Aircraft Operational Control level	Specific function that shall be held by the personnel that performs activities related with the Operation Control. Depending on the CAMO scope and complexity, this task can be performed in accumulation with the Aircraft Maintenance Control level but considering the difference in the scope of the tasks it was decided to keep these functions separate.
Aircraft Maintenance Control level	Specific function that shall be held by the personnel that performs activities related with the Maintenance Control. As described before depending on the CAMO scope and complexity, this task can be performed in accumulation with the Aircraft Operational Control level but considering the difference in the scope of the tasks it was decided to keep these functions separate.
Human Resources Area level	Considering the specific tasks to be performed in the Human Resources Management needs, it was necessary to consider an organizational level to perform these tasks, independently if a CAMO accumulate these functions with other areas.
Facility Area Level	Considering the specific tasks to be performed in the Facility Management needs, it was necessary to consider an organizational level to perform these tasks, independently if a CAMO accumulate these functions with other areas.
Procurement Area Level	Considering the specific tasks to be performed in the Procurement Management needs, it was necessary to consider an organizational

	level to perform these tasks, independently if a CAMO accumulate these functions with other areas.

Each of the processes identified in table 10 was designed having as base the requirements that must be complied integrated with the functions responsibilities identified in table 11 and table 12. To develop and design CAMO processes and to facilitate the view of the relation between the processes and function, a crosscheck table was developed. This table shows the relation between the functions and the processes which can be seen on the following figure:

		Management level	Safety level	Airworthiness level	Compliance level	Airworhiness Review Staff level	Permit to Fly Staff level	Pre-Flight level	Operational level	Approval level	Audit Team level	Reporting level	Investigation level	Aircraft Operational Control level	Aircraft Maintenance Control level	HR Area Level	Facility Area Level	Procurement Area Level
1.1	Documental Management				x				x	x								
1.2	Risk Management		x		x													
1.3	System Monitoring	x	x						x									
2.1	Audit Management				x					x	x							
2.2	Findings Management				x				x									
2.3	Internal Reporting				x							x						
2.4	Internal Investigation									x			x					
2.5	Occurrence Reporting		x															
3.1	Operation Control			x										x				
3.2	Pre-Flight Inspection							x										
3.3	Maintenance Control			x											x			
3.4	Maintenance Planning			x														
3.5	Permit to Fly Issuance			x			x											
4.1	Data Management			x														
4.2	Reliability Management			x														
4.3	AMP Management			x														
4.4	AD Management			x														
4.5	Configuration Management			x														
4.6	Aircraft AW transfer			x														
5.1	AW Review Evaluation			x														
5.2	AW Review Issuance			x														
6.1	HR Planning				x											x		
6.2	HR Recruitment															x		
6.3	HR Qualification Control				x													
7.1	Facility Planning Control																x	
7.2	Facility Report															x	x	
8.1	Contracting/Subcontracting																	x
8.2	Service/Product provider control																	x

Figure 16 - Processes and function levels crosscheck

This crosscheck provides a clear view of the functional levels' intervention required during the processes. This figure gives a first level of information to develop the process design detail required.

4.4. CAMO PROCESSES FRAMEWORK APPROACH

As defined in the literature review a Business Architecture “shall describe and define which and how business processes interact with each other as results from the implementation of business strategies” (Sousa et al. 2005). The principal goal of the airworthiness requirements is to establish the necessary framework that Organizations, persons and material must comply to ensure that each aircraft operates in a safety environment. The defined requirements give to all stakeholders the basis how organizational processes shall perform their activities to comply with the safety purpose.

After regulation analyses and processes identification trough the paragraphs 4.1, 4.2 and 4.3, and due to CAMO requirements complexity, was considered that a three-level process scheme shall be adopted. From the regulation analyses emerged a two high level process scheme and a more detailed third level. At his lower level each of the identified processes can be designed based on the applied requirements, the identified tasks, and the related documentation. For this design will be used Business Process Modelling Notation (BPMN). So being the process architecture developed within this work will then have the following structure as the figure resumes:

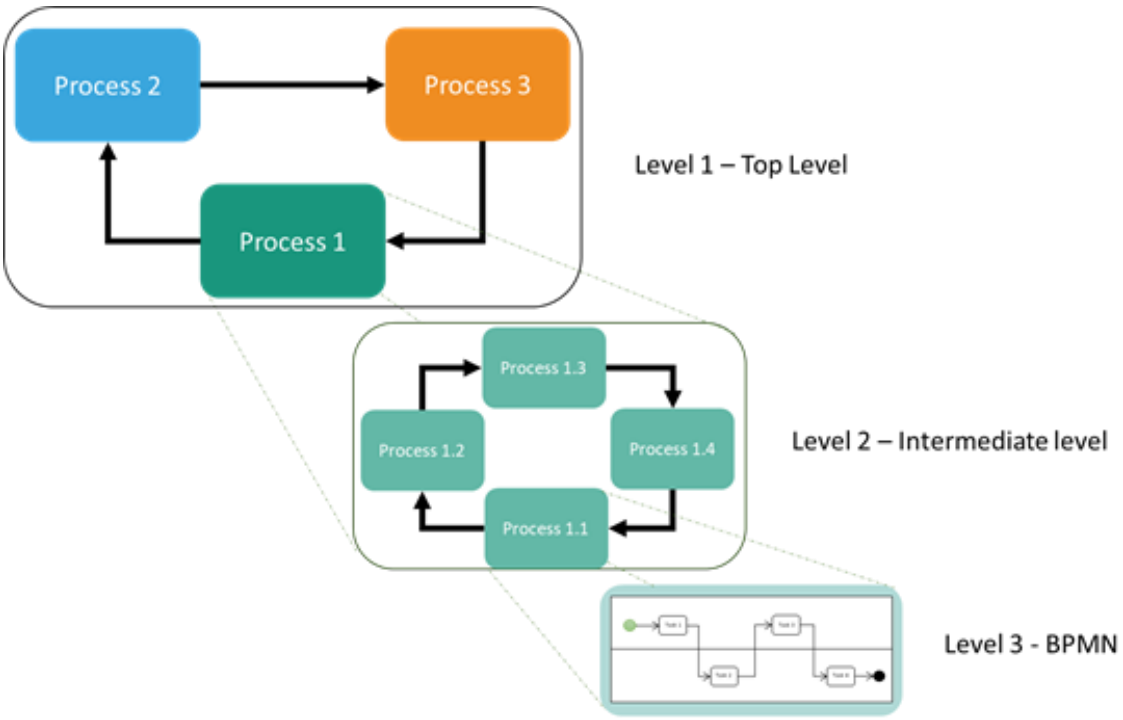


Figure 17 - Process Structure proposal

The process identification had a top-down approach where each CAMO requirement was analyzed and evaluated from high level to a low lever functional boundary. On the contrary, the architecture design will have a bottom-up approach. Starting from the requirement detailed evaluation the processes will be design from the lower level until achieving the top-level architecture. The lower-level design with BPMN with table 44 framework analyses will provide the necessary information to identify the informational specifications that will also enable the development of the informational architecture. In the following paragraphs will be possible to follow the architectures development and final proposal.

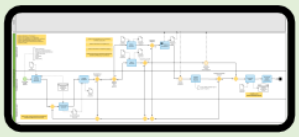
5. CAMO BUSINESS PROCESS ARCHITECTURE

5.1. CAMO PROCESSES LEVEL 3 DESIGN

To proceed to BPMN design was necessary to get a framework for each process. For that were developed the following tables (table 13 to table 40). These tables are used to clarify all the individual designed process in BPMN. In each table there is a description of each process, the organizational function level, the information required and the information generated so that the process can be held. In this scope information are described in terms of documents or systems which in this context "system" means a data or records repository in structured form. This will be discussed with higher level of detail in the informational architecture paragraph.

For each table it's also defined the diagram SIPOC (Suppliers, Input, Process, Output, Clients), which describes the boundaries of the process and the process itself. The Suppliers identifies the process or entity (internal or external) that can deliver the Input to trigger the designed process. It's also identified the output of the process and the clients where that Output can be delivered. These Clients can be another process or an entity (internal or external). In the column process there is a link to the BPMN process that can be seen in Appendix's figures. All the processes were numerated to a better reference and during the BPMN design there are labels that identify the CAMO requirement that that task, data container or other object complies.

Table 13 - Documental Management SIPOC

Process Level 1	1 - Strategic Management			
Process Level 2	1.1 - Documental Management			
Description				
This process begins when a documental change is required to answer to any request from top management or authority requirement. It also can be activated from an improvement action to be developed. This process has 3 levels of actions with an operational level that could be any area that must participate on the document's development of that area, the compliance level to check the requirements accomplishment and the approval level that is responsible to approve the documents. According to the requirements there are some documents that must have to be approved by the Competent Authority. The output of this process are all organization documents required like CAME, policy, functional responsibility charts and other specific procedures which defines all CAMO processes but also defines orientation and procedures to CAMO Personnel.				
Suppliers	Input	Process	Output	Clients
System Monitoring Process Competent Authority CAMO	New Requirement	 **Appendix - Figure 31**	Document Approved	CAMO

Functions level	Operational level; Compliance level; Approval level
Required Information	Document Management System
Generated Information	Document Management System; Document Approved

Table 14 - Risk Management SIPOC

Process Level 1	1 - Strategic Management			
Process Level 2	1.2 - Risk Management			
Description				
This is a continuous process that requires a constant hazard identification, risk assessment and evaluation and then the definition of actions to mitigate it in case of the risk has not an acceptable level. The hazard identification is feed by the daily collected data from all reports, investigation and evaluation performed all over the systems. The output of this process generates information for the System Monitoring but overall, the necessary the action plans for all CAMO sectors comply to be able to mitigate the identified risks. This process can be activated by any process when any finding or situation requires the management risk update. This process it's required needed when it's necessary to contract a maintenance service or subcontract a CAMO activity.				
Suppliers	Input	Process	Output	Clients
Risk Management Process System Monitoring Process CAMO	Risk Management cycle Risk action plan (last cycle) Risk update request	 **Appendix - Figure 32**	Risk action plan	Risk Management process CAMO
Functions level	Safety level			
Required Information	Management Systems			
Generated Information	Risk Management System; Risk Action plan			

Table 15 - System Monitoring SIPOC

Process Level 1	1 - Strategic Management
Process Level 2	1.3 - System Monitoring
Description	
This is a continuous management process that has an operation cycle to be developed and uses all management data generated by the CAMO management system to develop performance and safety reports and goals definition. This information is used to management and safety board define and control organization goals and actions to be held at different organizational structure hierarchy. This process output feed up the CAMO Organizational Structure and Processes responsible.	

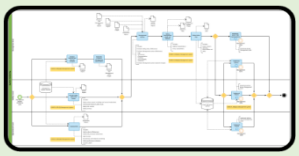
Suppliers	Input	Process	Output	Clients
System Monitoring Process CAMO Owners	System Monitoring cycle Changes required CAMO Goals (last cycle) CAMO Action plan (last cycle)	 **Appendix - Figure 33**	CAMO Results Report CAMO Goals plan CAMO Action plan	System Monitoring Process Risk Management Documental Management CAMO Owners CAMO
Functions level	Operational level; Safety level; Management level; Safety Board level			
Required Information	Management Systems			
Generated Information	Management Control System; CAMO Results Report; CAMO Action Plan; CAMO Goals Plan			

Table 16 - Audit Management SIPOC

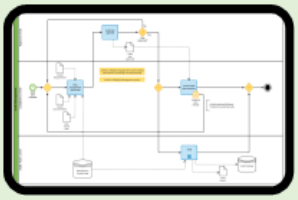
Process Level 1	2 - Compliance Management			
Process Level 2	2.1 - Audit Management			
Description				
The Audit Management process is a systematic compliance check if CAMO complies with the established requirements. This is a cycle process that contains the audit planning and control and the audit sub-process. This audit realization can be performed by any element that is qualified for do it. This process was developed in accordance with bases defined in ISO19011 - Guidelines for auditing management systems where the audit best practices are defined.				
Suppliers	Input	Process	Output	Clients
Audit Management Process	Audit Cycle Last Audit Plan	 **Appendix - Figure 34**	Audit Plan Audit Report	Audit Management Process Finding Management Process
Functions level	Audit Team level; Compliance level; Approval level			
Required Information	Management Systems; CAMO Documentation; CAMO Requirements; Risk Action Plan			
Generated Information	Audit Plan; Audit Report			

Table 17 - Finding Management SIPOC

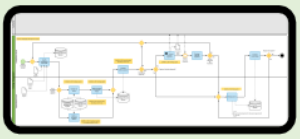
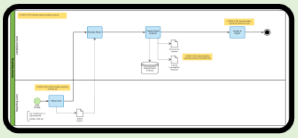
Process Level 1	2 - Compliance Management			
Process Level 2	2.2 - Finding Management			
Description				
In the Finding Management process the compliance level must identify and guarantee that the CAMO area responsible for the finding treatment develop the necessary actions to eliminate the finding but also identify and eliminate the cause that promote that finding. The findings can come from Internal Reporting, internal or external Audits, or Occurrence issues. The external audit can be made by the Competent Authority, by a client or any other recognized identity. This process also contains the necessary actions any issue to report to Competent Authority as necessary.				
Suppliers	Input	Process	Output	Clients
Audit Management Process Internal Reporting Competent Authority Aircraft Owner / Air Operator AW Review Client	Finding Treatment Request Audit Report Internal Report External audit reports	 **Appendix - Figure 35**	Corrective Actions taken Corrective Action Report	CAMO Competent Authority Aircraft Owner / Air Operator AW Review Client
Functions level	Operational level; Compliance level			
Required Information	Internal Report Records System; Finding Records System; Document Management System			
Generated Information	Finding Records System; Corrective Action Report			

Table 18 - Internal Reporting SIPOC

Process Level 1	2 - Compliance Management			
Process Level 2	2.3 - Internal Reporting			
Description				
All the CAMO personnel are called to report any issue that goes against safety or other undesired situation. Depending on the report scope or reported situation the process to follow the Internal Reporting can be a deeper investigation, a finding treatment an if required to proceed to an occurrence report to authority.				
Suppliers	Input	Process	Output	Clients
CAMO	Issue finding	 **Appendix - Figure 36**	Occurrence request	Occurrence Reporting process

			Internal Investigation request Finding Treatment Request	Internal Investigation process Finding Management process
Functions level	Reporting level; Compliance level			
Required Information	N/A			
Generated Information	Internal Report Records System; Finding Report; Internal Report Status			

Table 19 - Internal Investigation SIPOC

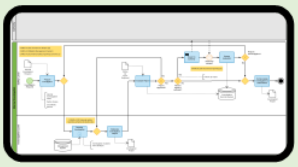
Process Level 1	2 - Compliance Management			
Process Level 2	2.4 - Internal Investigation			
Description				
When an occurrence (accident, incident, technical defect, malfunction, etc.) has happened or a report that requires a deeper investigation, it's necessary to proceed to an independent investigation to identify occurrence causes and promote actions to avoid repeated occurrences. This process is led by the safety level but shall be executed by an independent investigation team to be nominated. This process includes the follow up report communication to authority if required by them.				
Suppliers	Input	Process	Output	Clients
Internal Reporting Occurrence Reporting	Internal Investigation request	 **Appendix - Figure 37**	Investigation Report	CAMO Client Competent Authority
Functions level	Investigation level; Safety level			
Required Information	Management System			
Generated Information	Investigation Records System; Investigation Report			

Table 20 - Occurrence Reporting SIPOC

Process Level 1	2 - Compliance Management
Process Level 2	2.5 - Occurrence Reporting
Description	
When an occurrence (accident, incident, technical defect, malfunction, etc.) as happened it's necessary to report the occurrence within 73-hour max to the Competent Authority. This report shall also be made	

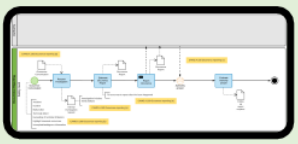
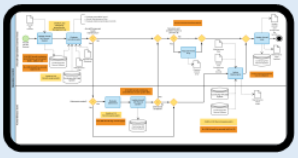
to the Type Certificate holder. This process defines the tasks to be performed. With the Occurrence process the Internal Investigation process shall be started.				
Suppliers	Input	Process	Output	Clients
Internal Reporting Aircraft Owner / Air Operator MRO	Occurrence communicated	 **Appendix - Figure 38**	Internal Investigation request	Internal Investigation process Type Certificate Post Holder
Functions level	Safety level			
Required Information	Occurrence Communication			
Generated Information	Occurrence Report; Follow Up report request			

Table 21 - Operation Control SIPOC

Process Level 1	3 - Aircraft Management			
Process Level 2	3.1 - Operation Control			
Description				
This process is the interface between CAMO and the aircraft operation. After each fly, all the records about the mission accomplishment must be recorded in terms of time limit consumptions, defects or malfunctions detected or any reported made by the operator. If any maintenance is required, the aircraft must be induced to the contracted maintenance provider. However, if the reported deficiency fits as it can be deferred in accordance with the defined requirements, it can be requested that deferment and must be recorded. In specific conditions it can be also requested a permit to fly if specific operation conditions are met and controlled.				
Suppliers	Input	Process	Output	Clients
Aircraft Owner / Air Operator Pre-Flight Inspection Process Maintenance Planning	Aircraft not airworthy Aircraft Log Records Maintenance Plan	 **Appendix - Figure 39**	Aircraft Log Records Updated Aircraft Ready to Pre-Flight Aircraft Not Airworthy Maintenance Work order Request for Permit to fly	Pre-Flight Inspection Process Maintenance Control process Permit to Fly Process
Functions level	Aircraft Operational Control level; Engineering Support level			

Required Information	Continuing AW Data System; Continuing AW Record System; Aircraft Log Records; Component technical log Records; Operational Schedule
Generated Information	Continuing AW Record System; Aircraft Log Records; Component Log Records

Table 22 - Pre-Flight Inspection SIPOC

Process Level 1	3 - Aircraft Management			
Process Level 2	3.2 - Pre-Flight Inspection			
Description				
Before each Fly CAMO is responsible for the Pre-Flight Inspection. Depending on the aircraft type this task can be performed by different technical experts. The requirement to develop these tasks is to have the necessary training to do it. From the Pre-Flight Inspection the aircraft is airworthy or it can be requested maintenance support if any deficiency is detected. If necessary and for some reason the aircraft is Nor Airworthy from result of Pre-Inspection, the process returns to Operation Control and then heavy maintenance is requested again.				
Suppliers	Input	Process	Output	Clients
Operation Control Process Permit to Fly Issuance Maintenance Control MRO	Permit to Fly (if necessary) Aircraft Ready to Pre-Flight	 **Appendix - Figure 40**	Maintenance request Aircraft Not Airworthy Aircraft Log Records updated Aircraft Airworthy	MRO Operation Control process Aircraft Owner / Air Operator
Functions level	Pre-Flight Staff level			
Required Information	Continuing AW Data System; Continuing AW Record System; Aircraft Log Records			
Generated Information	Continuing AW Record System; Aircraft Log Records			

Table 23 - Maintenance Control SIPOC

Process Level 1	3 - Aircraft Management
Process Level 2	3.3 - Maintenance Control
Description	
CAMO is responsible for controlling all the maintenance on each aircraft. This process begins with the aircraft induction to maintenance in the contracted MRO (if external) or in the maintenance process if the Organization were CAMO belongs has also a maintenance included. This process includes the necessary support to any identified deficiency that MRO can't handle for any reason. If necessary, during engineering support it may be necessary to contact a DOA or the Type Certificate Post Holder to request technical instructions to the identified issue. This process also contains deferment task as necessary to anomalies found that don't are safety related and can be deferred. All the maintenance	

<table>
<tr><td colspan="5">records performed by the MRO shall be received during this process. This will update the Aircraft Continuing Record System. These records include any maintenance, mass and balance tasks, completes instructions (Airworthiness Directives, Service Bulletins, etc.), modifications or configuration changes performed by the MRO.</td></tr>
<tr><th>Suppliers</th><th>Input</th><th>Process</th><th>Output</th><th>Clients</th></tr>
<tr><td>Operation Control Process</td><td>Aircraft Not Airworthy

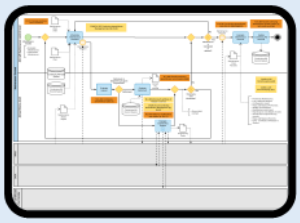
Maintenance Work order</td><td> 
Appendix - Figure 41</td><td>Aircraft Ready to Pre-Flight</td><td>Pre-Flight Inspection process</td></tr>
<tr><td>Functions level</td><td colspan="4">Aircraft Maintenance Control level; Engineering Support level</td></tr>
<tr><td>Required Information</td><td colspan="4">Continuing AW Data System; Continuing AW Record System; Maintenance Plan; Maintenance Final Records (includes Mass and Balance Records, Certificate of Release to Service (CRS), Aircraft Log Records, Components Log Records)</td></tr>
<tr><td>Generated Information</td><td colspan="4">Continuing AW Record System</td></tr>
</table>

Table 24 - Maintenance Planning SIPOC

<table>
<tr><td>Process Level 1</td><td colspan="4">3 - Aircraft Management</td></tr>
<tr><td>Process Level 2</td><td colspan="4">3.4 - Maintenance Planning</td></tr>
<tr><td colspan="5">Description</td></tr>
<tr><td colspan="5">To develop the necessary maintenance required to guarantee aircraft airworthiness is necessary to plan high level maintenance plan for all aircraft managed by a CAMO. To perform this planning, it’s necessary consider operational needs, the available resources, the defined goals from the top management structure and the Aircraft Maintenance Program for each aircraft. The output of this process is the maintenance plan to be accomplished. If necessary, during this process it will be necessary to define the requirements needed and with those require the maintenance contracting through the procurement process to guarantee that maintenance will be handled when required.</td></tr>
<tr><th>Suppliers</th><th>Input</th><th>Process</th><th>Output</th><th>Clients</th></tr>
<tr><td>Maintenance Planning process

Aircraft Owner / Air Operator</td><td>Planning Cycle

Operational requirements</td><td> 
Appendix - Figure 42</td><td>Maintenance Plan</td><td>Maintenance Planning process

Operation Control Process</td></tr>
<tr><td>Functions level</td><td colspan="4">Airworthiness level</td></tr>
<tr><td>Required Information</td><td colspan="4">Continuing AW Data System; Management Control System; Provider System; Continuing AW Record System; Service/Product Contract</td></tr>
<tr><td>Generated Information</td><td colspan="4">Continuing AW Record System; Service request; Maintenance Plan</td></tr>
</table>

Table 25 - Permit to Fly Issuance SIPOC

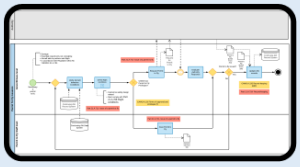
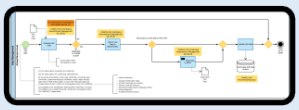
Process Level 1	3 - Aircraft Management			
Process Level 2	3.5 - Permit to Fly Issuance			
Description				
In some conditions it's possible a CAMO to issue or request the issue of a permit to fly even if airworthiness requirements aren't met. The emission of a permit to fly emission must be under controlled conditions and may be established flight restrictions. This process defines the tasks to be performed if the CAMO has permit to fly privileges (EASA Form 20b) or if must be requested to the Competent Authority (EASA Form 20a). Only specific personnel can issue a permit to fly.				
Suppliers	Input	Process	Output	Clients
Operation Control process	Request Permit to Fly	 **Appendix - Figure 43**	Permit to Fly (EASA Form 20a/20b)	Pre-Flight Inspection process
Functions level	Airworthiness level; Permit to Fly Staff level			
Required Information	Continuing Airworthiness Record System; Continuing AW Data System			
Generated Information	Request for Permit to Fly; Permit to Fly (EASA Form 20a/20b)			

Table 26 - Data Management SIPOC

Process Level 1	4 - Aircraft Management			
Process Level 2	4.1 - Data Management			
Description				
This process defines the necessary tasks to evaluate if the data provided is applied to the aircraft CAMO scope. Within airworthiness requirements data is referred to any technical instructions, technical data, maintenance manuals that defines a technical procedure to be taken during the maintenance or can influence the operation. The technical data can be issued by Competent Authority, a Type Certificate Post Holder or a DOA. It also includes the necessary communication to all the stakeholders is any update is issued and applied. MRO shall be informed of any alteration. The output of this process can redefine configuration management or the AMP.				
Suppliers	Input	Process	Output	Clients
Aircraft AW Transfer Competent Authority Type Certificate Post Holder DOA	New Aircraft AW Data	 **Appendix - Figure 44**	Continuing AW Data Update	Configuration Management process AMP Management process

Functions level	Airworthiness level
Required Information	New Aircraft AW Data
Generated Information	Continuing AW Data System; Applicable AW Data

Table 27 - Reliability Management SIPOC

Process Level 1	4 - Aircraft Management			
Process Level 2	4.2 - Reliability Management			
Description				
The Reliability Management process is composed by a cycle reliability analysis to verify if the AMP is adequate to the aircraft operation in terms of effectiveness and efficiency. The reliability program can be updated if the basic data configuration is updated or if the AMP is updated. The product of this process is the development of reliability reports that can propose AMP improvements. Depending on the aircraft complexity this process may not be necessary to be performed, however it's always advisable to have a specific aircraft reliability program.				
Suppliers	Input	Process	Output	Clients
Reliability Management process AMP Management process Configuration Management process	Reliability evaluation cycle Reliability Program Continuing AW Data Update (AMP, Configuration)	 **Appendix - Figure 45**	Reliability Program Update Reliability Report	Reliability Management process AMP Management process
Functions level	Airworthiness level			
Required Information	Continuing AW Data System; Continuing AW Record System; Finding Records System			
Generated Information	Reliability System; Reliability Report			

Table 28 - Aircraft Maintenance Program Management SIPOC

Process Level 1	4 - Aircraft Management
Process Level 2	4.3 - AMP Management
Description	
The AMP Management is a cycle process that uses the applicable airworthiness data available, the operational requirements and the reliability information to update the AMP as required to make it more suitable to the aircraft operation assuring the accomplishment of the necessary requirements. The AMP is the document that defines all the maintenance to be performed on the aircraft and shall be	

<table>
<tr><td colspan="5">continuous updated. The AMP is a document that must be approved by the Competent Authority if the CAMO doesn’t have the privileges to do it. The AMP approval will promote the update of the necessary maintenance tasks to be performed in the aircraft.</td></tr>
<tr><td>Suppliers</td><td>Input</td><td>Process</td><td>Output</td><td>Clients</td></tr>
<tr><td>AMP Management process

Reliability Management process

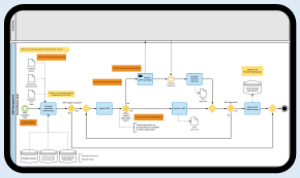
Data Management process

Directives Management

Aircraft Owner / Air Operator</td><td>AMP evaluation cycle

Reliability Report

Continuing AW Data System Update (AMP, Directives)

Operational Requirements</td><td> 
Appendix - Figure 46</td><td>AMP updated

Continuing AW Data System Update (AMP)</td><td>AMP Management process

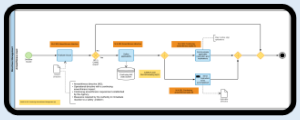
Configuration management process

Reliability Management</td></tr>
<tr><td>Functions level</td><td colspan="4">Airworthiness level</td></tr>
<tr><td>Required Information</td><td colspan="4">Continuing AW Record System; Reliability System; Reliability Report; Applicable AW Data</td></tr>
<tr><td>Generated Information</td><td colspan="4">Continuing AW Data System; AMP Approved</td></tr>
</table>

Table 29 - Directives Management SIPOC

<table>
<tr><td>Process Level 1</td><td colspan="4">4 - Aircraft Management</td></tr>
<tr><td>Process Level 2</td><td colspan="4">4.4 - Directives Management</td></tr>
<tr><td colspan="5">Description</td></tr>
<tr><td colspan="5">The Directive Management process contains the tasks to evaluate if any Airworthiness Directive (AD), Operational Directive with a continuing airworthiness impact, Continuing Airworthiness requirement established by the Agency, or any measure required by the Competent Authority that requires an immediate reaction to a safety problem is applied to CAMO scope. These directives shall be applicable as required and can promote AMP update.</td></tr>
<tr><td>Suppliers</td><td>Input</td><td>Process</td><td>Output</td><td>Clients</td></tr>
<tr><td>Competent Authority

Type Certificate Post Holder

DOA</td><td>New Issued Directive</td><td> 
Appendix - Figure 47</td><td>Applicable Directives

Aircraft Continuing AW Data (Directives)</td><td>AMP Management process

MRO</td></tr>
</table>

Functions level	Airworthiness level
Required Information	Directives
Generated Information	Continuing AW Data System; Directive

Table 30 - Configuration Management SIPOC

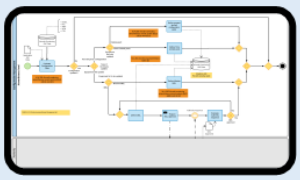
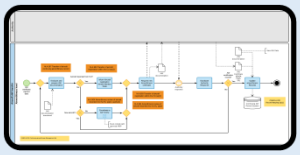
Process Level 1	4 - Aircraft Management			
Process Level 2	4.5 - Configuration Management			
Description				
The Configuration Management is an essential airworthiness management process where the aircrafts configuration is established according with from the aircraft applicable data available. Within this process is specified the aircraft possible configuration, are identified the component and equipment possible to be installed and are defined the respective configuration characteristics as the time limit for each aircraft or component. The input for this process is the applied airworthiness data, namely the Master Minimum Equipment List (MMEL), the Illustrated Parts Catalogue (IPC), the aircraft maintenance Program (AMP), the Aircraft Flight Manual (AFM) and Critical Design Limits (CDL). During this process shall be defined the Minimum Equipment List (MEL), that must be approved by the authority and the Mission Equipment List that can be approved within CAMO scope. The output of this process is the possible aircraft configurations that shall provide the necessary data to be used during the Reliability Management process but also the data to be used within the Aircraft Management Process.				
Suppliers	Input	Process	Output	Clients
AMP Management process Data Management process	Continuing AW Data System Update (MMEL, IPC, AMP, AFM, CDL)	 **Appendix - Figure 48**	Continuing AW Data System Update (Configuration) MEL Approved	AMP Management process MRO
Functions level	Airworthiness level			
Required Information	Continuing AW Data system; Applicable AW Data			
Generated Information	Continuing AW Data System			

Table 31 - Aircraft Airworthiness transfer SIPOC

Process Level 1	4 - Aircraft Management
Process Level 2	4.6 - Aircraft Airworthiness transfer
Description	
The transfer of an aircraft from one CAMO for another requires an evaluation from the CAMO that receives that aircraft. Depending on if the aircraft came from an EU member state and if is new aircraft	

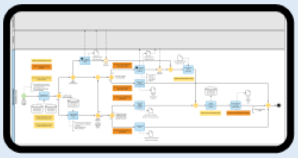
<table>
<tr><td colspan="5">the treatment shall be different. An aircraft that is imported from the UE doesn’t require an airworthiness review process. However, if it came from outside the EU and is not a new aircraft it’s necessary to proceed to a full airworthiness review. In any case it’s necessary to request an airworthiness certificate to the Competent Authority.</td></tr>
<tr><th>Suppliers</th><th>Input</th><th>Process</th><th>Output</th><th>Clients</th></tr>
<tr><td>Aircraft Owner / Air Operator</td><td>AW documentation transfer</td><td> 
Appendix - Figure 49</td><td>Aircraft AW Certificate (EASA Form 25)

New AW documentation (New AW Data)</td><td>Aircraft Owner / Air Operator

Data Management</td></tr>
<tr><td>Functions level</td><td colspan="4">Airworthiness level</td></tr>
<tr><td>Required Information</td><td colspan="4">Continuing AW Record System</td></tr>
<tr><td>Generated Information</td><td colspan="4">Continuing AW Record System</td></tr>
</table>

Table 32 - Airworthiness Review Evaluation SIPOC

<table>
<tr><td>Process Level 1</td><td colspan="4">5 - Airworthiness Review Management</td></tr>
<tr><td>Process Level 2</td><td colspan="4">5.1 - Airworthiness Review Evaluation</td></tr>
<tr><td colspan="5">Description</td></tr>
<tr><td colspan="5">The Airworthiness Review Evaluation is a necessary cycle process to check the necessary action to perform the Airworthiness Review to be performed. The Airworthiness Review is a cycle documental and physical check and shall be performed depending on the CAMO privileges and the type of aircraft. If CAMO has no Airworthiness review privileges can request to authority to perform this review or can subcontract a CAMO with privileges to do it. In case of having the AW Review Privileges, CAMO must guarantee that the aircraft has been in a controlled environment last 12 months (AW continuously managed by a unique CAMO or CAO in last 12 months and been maintained by Part-145/Part-CAO organization) or else it must be a request Competent Authority. An Airworthiness Review certificate can be extended 2 times the most if the aircraft is maintained in a controlled environment. If CAMO has no AW Review privileges but is responsible by Air Carrier or an Aircraft Above 3470 Kg shall request an AW Review recommendation before request the certification to the Competent Authority. If the certificate is issued by an authorized CAMO shall be used Form 15b. If it’s issued by the Competent Authority is used Form 15a.</td></tr>
<tr><th>Suppliers</th><th>Input</th><th>Process</th><th>Output</th><th>Clients</th></tr>
<tr><td>AW Review Evaluation</td><td>AW Review cycle

AW Review Certificate renewal needed</td><td> 
Appendix - Figure 50</td><td>AW Review Certificate validated (EASA Form 15a/15b)

Request for Airworthiness</td><td>AW Review Evaluation

AW Review Issuance</td></tr>
</table>

			Review/ Recommendation	
Functions level	Airworthiness level			
Required Information	Continuing AW Record System			
Generated Information	Continuing AW Record System; AW Review Certificate validated			

Table 33 - Airworthiness Review Issuance SIPOC

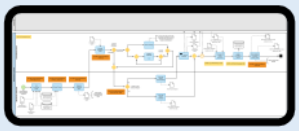
Process Level 1	5 - Airworthiness Review Management			
Process Level 2	5.2 - Airworthiness Review Issuance			
Description				
This process contains the necessary tasks to CAMO issue the Airworthiness Review Certificate or provide the Airworthiness Review recommendation to Competent Authority issue that certificate as applicable. The review tasks must be performed by the Airworthiness Review Staff. In case of the review being inconclusive or findings are identified, they should be treated and authority shall be informed. If CAMO as Airworthiness Review privileges it can issue the certificate, otherwise, as requested, it shall issue a recommendation to Competent Authority to issue the necessary certificate. The output of this process is the issuance of the Airworthiness certificate independently whoever has issued it. This is a process that can be subcontracted to other CAMO.				
Suppliers	Input	Process	Output	Clients
AW Review Evaluation AW Review Client	Request for Airworthiness Review/ Recommendation	 **Appendix - Figure 51**	AW Review Certificate (issued or extended)	AW Review Evaluation process AW Review Client
Functions level	Airworthiness level; Airworthiness Review Staff level			
Required Information	Continuing AW Record System; Continuing AW Data system			
Generated Information	Continuing AW Record System; AW Review Certificate validated; Physical Survey Report; Compliance Report; AW Review Certificate (EASA Form 15a/15b)			

Table 34 - Human Resources Planning SIPOC

Process Level 1	6 - Human Resources Management
Process Level 2	6.1 - Human Resources Planning
Description	
The Human Resource Planning process allows to CAMO plan the HR needed during a planning cycle. This held to a predictive recruitment and formation that allows personnel fulfill or maintain the qualifications requirements so that they can perform their job function. This process is composed by a requirement job continuous evaluation to update the job functions description as necessary, a	

<table>
<tr><td colspan="5">personnel performance evaluation to verify which qualifications shall be improved or refreshed and an evaluation of personnel quantities to verify if the number of staff is adequate to the CAMO volume of work. The output of this process is the training and hiring plan to be executed during the cycle to ensure personnel performance and requirement compliance.</td></tr>
<tr><th>Suppliers</th><th>Input</th><th>Process</th><th>Output</th><th>Clients</th></tr>
<tr><td>HR Planning process</td><td>Human Planning Cycle

Hiring Plan updated (last cycle)

Training plan updated (last cycle)</td><td> 
Appendix - Figure 52</td><td>Training plan

Hiring Plan</td><td>HR Planning process

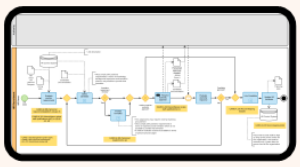
HR Recruitment process

HR Qualification process</td></tr>
<tr><td>Functions level</td><td colspan="4">Airworthiness level; HR Area Level</td></tr>
<tr><td>Required Information</td><td colspan="4">HR Control System; Management Control System</td></tr>
<tr><td>Generated Information</td><td colspan="4">HR Control System; Hiring Plan; Training Plan</td></tr>
</table>

Table 35 - Human Resources Recruitment SIPOC

<table>
<tr><td>Process Level 1</td><td colspan="4">6 - Human Resources Management</td></tr>
<tr><td>Process Level 2</td><td colspan="4">6.2 - Human Resources Recruitment</td></tr>
<tr><td colspan="5">Description</td></tr>
<tr><td colspan="5">The Human Resource (HR) recruitment process includes the tasks to ensure that the candidates to be hired shall comply with the defined requirements independently the job to be fulfilled (from post holders' managers, technicians, AW Review staff, etc.). Some specific functions need to be approved by the Competent Authority. This process follows the HR planning but is also prepared to give answer to a not planned HR need. This process also predicts the necessary training action to be developed for a candidate before the recruitment formalization if required. The final output of this process is to hire the candidate and guarantee that HR records are updated.</td></tr>
<tr><th>Suppliers</th><th>Input</th><th>Process</th><th>Output</th><th>Clients</th></tr>
<tr><td>HR Planning process

CAMO</td><td>Hiring Plan

HR need not planned</td><td> 
Appendix - Figure 53</td><td>Training plan updated

Personnel hired</td><td>HR Qualification process

CAMO</td></tr>
<tr><td>Functions level</td><td colspan="4">HR Area Level</td></tr>
<tr><td>Required Information</td><td colspan="4">HR Control System</td></tr>
<tr><td>Generated Information</td><td colspan="4">HR Control System; Personnel approval request (EASA Form 4); Training Plan</td></tr>
</table>

Table 36 - Human Resources Qualification Control SIPOC

Process Level 1	6 - Human Resources Management			
Process Level 2	6.3 - Human Resources Qualification Control			
Description				
The Human Resources Qualification Control allows the control of the qualifications required so that the personnel may maintain their specific requirements functions accordingly with the established training plan. The training to be performed may be internal training or subcontracted. This process it's a continuous process to avoid that a qualification exceeds the expiry date and fulfill the training plan.				
Suppliers	Input	Process	Output	Clients
HR Qualification Control process HR Planning process HR Recruitment process	Qualification expired Training plan	**Appendix - Figure 54** 	Qualified Personnel	CAMO
Functions level	Airworthiness level; HR Area Level			
Required Information	HR Control System			
Generated Information	HR Control System			

Table 37 - Facility Planning and Control SIPOC

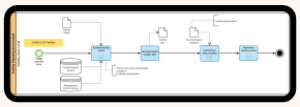
Process Level 1	7 - Facility Management			
Process Level 2	7.1 - Facility Planning and Control			
Description				
The Facility Planning and Control (HR) define the necessary task to promote and guarantee the facility requirements accomplishment with full conditions to personnel accomplish their jobs through a facility plan and consequent control execution. For that procurement process may be requested to contract a specific facility service provider. This process also is prepared to give the necessary answers to reports that need immediate actions to be performed.				
Suppliers	Input	Process	Output	Clients
Facility Planning and Control process Facility Report Process	Facility plan (last cycle) Facility Requirements	**Appendix - Figure 55** 	Facility updated	Facility Planning and Control process CAMO
Functions level	Facility Area Level			
Required Information	Facility Reports System; Facility Report			
Generated Information	Facility Plan; Service Product Request (Facility Provider)			

Table 38 - Facility Report SIPOC

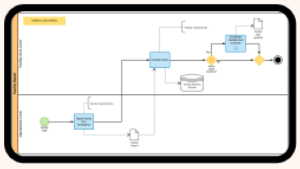
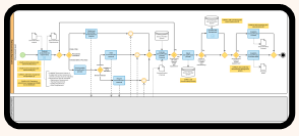
Process Level 1	7 - Facility Management			
Process Level 2	7.2 - Facility Report			
Description				
The Facility Report process able any personnel from the CAMO to report any facility issue. This report is evaluated by facility responsible and is introduced in Facility Reports System to future planning. If the issue to report is urgent then an immediate action shall be coordinated to resolve the identified issue. In this case the facility plan shall be updated and service may be contracted as required through the Facility Planning and Control process.				
Suppliers	Input	Process	Output	Clients
CAMO	Facility fault identified	 **Appendix - Figure 56**	Facility Report	Facility Planning and Control process
Functions level	Operational Level; Facility Area Level			
Required Information	Facility Reports System			
Generated Information	Facility Reports System			

Table 39 - Contracting/Subcontracting SIPOC

Process Level 1	8 - Procurement Management			
Process Level 2	8.1 - Contracting/Subcontracting			
Description				
The Contracting/Subcontracting is a procurement process that contains the activities to find the service or product provider independently the scope of the contract to be accomplished. This process is composed by a requirement evaluation task, following by a myriad of possible different approaches to procure the providers. The first one is through a public offer where the requirements are published and then the provider candidates and offer the service to be offer. The second it's through service invitation where are invited a specific number of providers that can offer the service/product to be contracted. The third option is directly purchase to a specific provider for the service or product to be acquired. Whatever the options to be taken, all the proposals shall be evaluated to check the requirements to be complied. After selecting the provider candidate, if the service is a maintenance service or a CAMO subcontracting activity, it's necessary to activate a Risk Management subprocess. Finally, the service or product purchase can be conducted through a contract or a purchase order depending on the scope and complexity of the service or product to be contracted.				
Suppliers	Input	Process	Output	Clients
CAMO	Service/Product request	 **Appendix - Figure 57**	Service/Product Provider (contract or Purchase Order	CAMO Provider Control process

Functions level	Procurement Level
Required Information	Service Provider System; Service/Product requirements (Maintenance, Training, Facility, other)
Generated Information	Service Provider System; Service/Product Contract; Purchase Order

Table 40 - Provider Control SIPOC

Process Level 1	8 - Procurement Management			
Process Level 2	8.2 - Provider Control			
Description				
The Provider Control process is continuous and cycling process that has the necessary tasks to guarantee that the established contract is being accomplished as required. If necessary, this process establish the mitigation actions to be developed in case any requirement isn't being accomplished. The service report shall update the Management Risk subprocess for the provider. Provider Control process is also ensured, in a continuous basis, the Service/Product Provider evaluation to build an historical log records of each provider services/products.				
Suppliers	Input	Process	Output	Clients
Provider Control process Contracting/ Subcontracting process	Provider evaluation cycle Service/Product Provider (contract or Purchase Order	 **Appendix - Figure 58**	Service/Product Provider System Updated (evaluation) Service report	Provider Control process CAMO
Functions level	Procurement Level			
Required Information	Service Provider System			
Generated Information	Service Provider System; Service Report			

With the process design, the inputs, the outputs, the required information and the generated information is possible to have a clearer vision how the identified processes interact with each other. During the BPMN design several data objects were identified, namely data systems, record systems, reports and other information forms that are important to be described to have a view of that their application. Remembering that in this context "system" was considered as a data or record structural repository, it was elaborated table 41 where each of the data object applied during the BPMN design are established:

Table 41 - BPMN Data Object description

Main BPMN Data Object	Description
Action Plan	Plan that defines the organizational actions to be performed and the respective responsible to do it.
Aircraft technical log Records	Aircraft record that resumes all the actions taken by aircraft, all the issues reported, all the consumptions and resumes for each mission, the technical deficiency reported and how they were handle when necessary.
AMP Approved	Specific document that establishes all the required maintenance necessary to be accomplished by an aircraft during its life cycle.
Applicable AW Data	Airworthiness data that is applicable within CAMO scope after the necessary evaluation.
Applicable Directive	Issued Directive applicable to the CAMO scope after the necessary evaluation.
Assessment Report	Report that provides for each CAMO operational area a resume of the results achieved, the difficulties, the lesson learned and main goals to achieve in the future. It shall include the following analyses by area: ▪ Safety culture effectiveness; ▪ Safety risk processes effectiveness; ▪ Staff surveys occurrences; ▪ Incident's monitoring; ▪ Safety performance Indicators; ▪ Lessons Learned.
Audit Plan	Plan to be developed by the safety area to establish the necessary audits to be performed during a management cycle. It shall include all the Part-CAMO requirements compliance evaluation.
Audit Report	Report developed by the audit team that shall identify in a systematic way the audit findings. This report shall be developed during the internal audits.
AW Certificate (EASA Form 25)	Document issued by the Competent Authority to certify that an aircraft is airworthy. It is issued accordingly with EASA Regulation (EU) No 748/2012 Part-21 Subpart H (EASA 2021) through EASA Form 25 (figure 75).
AW Documentation	All the airworthiness documentation transferred with the new aircraft that the receiving CAMO will manage. Includes all the necessary data that proves the aircraft airworthiness compliance. The documentation can be different depending on if the aircraft is new or it came from another operator or other CAMO. The documentation needed will also depend on if the aircraft came from a Member State or not.
AW Review Certificate (EASA Form 15a/15b)	Specific document that proves that the Airworthiness Review tasks have been made and the aircraft comply with necessary requirements to be safe to fly. This document can be issued by the Competent Authority (Form 15a - figure 71) or by a CAMO with specified privileges (Form 15b - figure 72).
CAMO Documentation	All the approved documents that define how CAMO shall operate, including plans, report, policies and others.
CAMO Requirements	All the requirements that CAMO must comply defined in the regulation or other specific applied document.
CAMO Results Report	Structured report that is produced to verify the CAMO performance.
Candidate Documentation	Candidate documentation is the set of documents that shows the person experience like the CV or the requirements compliance for the Job (for example the training certificates).
Changes Report	Report that resumes the internal and external organizational environmental changes that may influence CAMO vision, policy, objectives or processes.

Main BPMN Data Object	Description
Compliance Report	A compliance report is developed by the airworthiness review staff where is detailed the items checked, including the physical survey that has been carried out. It must include the evaluation of the compliance with the requirements.
Component technical log Records	Technical record that resumes a component life-limit consumption and the developed maintenance, in particularly all technical actions that were taken to resolve any anomaly.
Continuing AW Data System	Structured repository where aircraft data shall be recorded and being maintained up to date. This repository shall contain the AMP and consequently aircraft maintenance required, the aircraft and components manuals, the aircraft configuration control and specific documentation like MMEL, MEL, IPC, AFM and CDL, the safety directives and instructions to be developed and other data needed to guide the aircraft maintenance and operation control.
Continuing AW Record System	Structured repository where all the technical records from the aircraft and components shall be recorded, namely the daily configuration, the time limit consumptions, the identified deficiencies, the maintenance developed, the deferments approved, the mass and balance actions developed, the Airworthiness Review historical records, the Certificate of Release to Service, the issued Permit to Fly, etc.
Corrective Action Report	Developed report where shall be identified the causes analyses and evaluated the corrective actions needed to eliminate the findings issues.
Developed/updated Document	Document that hasn't yet been approved that was updated (new edition) or it was developed by the first time (Developed).
Document approved	Any management document that was approved by the required level like manuals, procedures, forms and others. Depending on the document scope and CAMO privileges it can be approved inside the CAMO or by the authority.
Document Management System	Organizational document repositor were management documents like manuals, procedures, forms and others are controlled and updated.
Document Validated	Document that was validated by the required organizational level but need to be approved by the Competent Authority.
Engineering Order	Technical document that defines or clarify a specific maintenance work defined by the authorized engineering level.
External Audit Report	Report developed by the external audit team that identify, in a systematic way, the audit findings. The external audit report can be made by Clients or by the Competent Authority.
Facility Plan	Plan to be develop during a management cycle that specify the facility schedule intervention required.
Facility Report	Specific Report where personal can describe a facility noncompliance requirement or occurrence that shall require an intervention.
Facility Reports System	Structured information repository of all the facilities reports, needs, requirements and actions taken within facility scope.
Finding Records System	Repository system where an identified finding issue is described, recorded and controlled. It shall also have the causes evaluation and the actions taken to eliminate that causes.
Finding Report	Report made by an internal stakeholder that may require internal treatment to return that finding to the required compliance.
Finding Treatment Request	Request to provide the required finding treatment that wasn't classified as a safety issue that doesn't require to be treated as an occurrence and doesn't require an internal investigation.

Main BPMN Data Object	Description
Follow up report request	Request to provide a report of the actions, analysis and subsequent collected information during the investigation.
Goals Plan	Developed plan that establishes the goals to achieved by the CAMO, by department or by process as determined, identifying each goal responsible.
Hiring Plan	Developed plan that establishes the Human Resources hiring needs schedule during a management cycle.
HR Control System	Structured information repository about CAMO Human Resources that allows the control of Human Resources general information, their job descriptions and needs, the training requirements, qualifications and evaluations.
HR need not planned Request	Request for a Human Resource hiring that was not planned. This shall be necessary when a key element is necessary to hire and CAMO needs to perform all the efforts to find the required and qualified person.
Internal Investigation Request	Request to provide a high detailed investigation about a reported issue or a specified occurrence.
Internal Report Records System	Structured repository where CAMO personal can report a safety or other situation issue that has been identified.
Investigation Report	Report to be developed by the investigation team that shall describe the performed investigation and evaluation made, the investigation object causes and define the recommended specific actions to be taken.
Issued Directive	Safety document issued by an authorized identity that requires analyses and implementation if applicable. Includes Airworthiness directive (AD), operational directive with a continuing airworthiness impact, Continuing Airworthiness requirements or other measures required by the Competent Authority that demands an immediate reaction.
Maintenance Final Records	Includes all the maintenance records produced by an MRO which may include: ▪ Performed maintenance; ▪ List of deferred defects; ▪ Configuration report; ▪ Mass and Balance performed; ▪ AD/BS accomplished; ▪ Modifications performed; ▪ Maintenance Check flights records; ▪ Aircraft and Components log records ▪ Mass and Balance records; ▪ Certificate of Release to Service (CRS) - Certificate issued by an approved MRO after any maintenance is done.
Maintenance Plan	Plan that defines the schedule for aircraft maintenance taking in account the CAMO goals, operator requirements and available resources.
Maintenance Status Report	Maintenance report elaborated by the MRO that identifies the maintenance work status evolution as previous defined with CAMO.
Maintenance Work order	Definition of aircraft tasks to be performed by the MRO according with applicable maintenance data.
Management Control System	Structured repository where are defined the Key Process Indicators (KPI), goals and actions to be managed by the requested organizational levels.
Management Cycle Report	Overall report that shall integrates the information provided by all CAMO areas. Shall include CAMO performance from the last management cycle.
Management Systems	This object is used to resume the need to integrate all the identified systems information in the CAMO for the process. This means that all data and records available may be used.

Main BPMN Data Object	Description
MEL Approved	Specific document with the Minimum Equipment List (MEL) necessary for the aircraft being fit to fly.
New AW Data	New Technical data issued by an authorized organization that can include technical instructions, repair/modification data, components/aircraft troubleshooting manuals, wiring diagrams and others documents necessary to guarantee aircraft airworthiness.
New requirement	A new requirement can be identified or required by CAMO staff or by a requested organizational change, an improvement opportunity or from a new requirement issued by the authority, the client or other stakeholder. The new requirement can promote a documental change in any document of documental system.
Occurrence Report	Report to be developed when an occurrence has happened to be send to the Competent Authority.
Occurrence Request	Request to open an occurrence report to be send to the Competent Authority once the issue that has happened must mandatorily have authority acknowledgement.
Operational Planning Needs	High level operational requirements that may influence the Maintenance Planning required to fulfill Aircraft Operation needs according with the available resources.
Operational Requirements	Aircraft operational requirements that influence the development of the AMP needed to provide the maintenance level required to the operation. This means that the AMP shall be established so that the aircraft can operate under specific conditions and limitations adequate to the required mission.
Operational Schedule	Low-level operational needs so that aircraft operational control can adjust the maintenance requirements to be accomplished or potentially deferred if applicable.
Permit to Fly (EASA Form 20a/20b)	Certificate to be issued when the aircraft doesn't comply will other airworthy requirements but still is fit to fly under specific conditions. It uses a specified form 20a (figure 73) if issued by the Competent Authority or 20b (figure 74) if issued by the authorized CAMO.
Personnel approval request	Necessary request to be made to Competent Authority to have some CAMO functions personnel approval when required.
Personnel approval request (EASA Form 4)	Request to Competent Authority for personnel approval so they can assume specified CAMO functions. Depending on the functions to be held, it may be necessary the use of the EASA Form 4 (figure 70) to request this approval.
Purchase Order	Document used to request a specific service acquisition when the complexity of the service doesn't require a contract to be established.
Reliability Program	Document that defines the data collection system, the evaluation, the analyses method and the performance requirements to evaluate the aircraft, the aircraft item or component performance for the required function in order to promote corrective actions that can increase AMP effectiveness (Federal Aviation Administration 2018).
Reliability Report	Report that indicates and suggest AMP update according with the reliability program approved.
Reliability System	Structured information repository where are established the reliability indicators related with the aircraft operation accordingly with the AMP.
Request external entity AW Review	Request to another CAMO with Airworthiness Review privileges or to the Authority the development of the Airworthiness Review tasks. If this is necessary, it means that CAMO doesn't have these privileges.

Main BPMN Data Object	Description
Request for Airworthiness Review	Request to CAMO Airworthiness Review staff to perform the Airworthiness review tasks to issue the Aircraft Airworthiness Review Certificate. This means that CAMO has Airworthiness Review privileges.
Request for Airworthiness Review Recommendation	Request to Airworthiness Review staff perform the required tasks to recommend to Competent Authority the issuance of the Airworthiness Review Certificate. This means that the CAMO hasn't the required Airworthiness Review privileges, but the aircraft type needs this recommendation.
Request to Permit to Fly	Request to evaluate the issuance of the permit to fly. This evaluation can be performed internally in a CAMO with the required privileges or it may be requested to the Competent Authority.
Risk Action plan	Report that defines the organizational actions and actions responsible to mitigate or eliminate the identified risk.
Risk Management System	Structured repository where shall be possible to identify hazards, assess and evaluate the risks and identify the actions to mitigate them. It shall also be possible to keep the risk level updated accordingly with the available data.
Safety Report	Specific safety evaluation report that must be provided during a management cycle that shall include: ▪ Safety review, trends, including new issue's introductions; ▪ Internal and External audits results; ▪ Safety risk controls; ▪ Safety surveys.
Service Provider System	Structured information repository with all the product and services providers, including historical contracts, services evaluations and lessons learned.
Service Report	Follow up report that shall contain the information about the service or product provider in terms of requirement accomplishment and service evaluation.
Service/Product Contract	Contract to be established with the Service/Product in other to fulfill the necessary requirements. In case of an MRO or CAMO specific requirements need to be considered.
Service/Product Proposal	Provider candidate proposal to provide the required service. It shall comply with defined requirements.
Service/Product Request	Request for acquisition of a specific service/product needed to maintain CAMO scope. It may be applied to MRO contracting, CAMO tasks subcontracting, training and facilities services acquisition or others. Any request to activate procurement process must comply with defined requirements within the best available conditions.
Service/Product Requirements	Established requirements that providers must comply to be able to provide a service or a product.
Training Plan	Plan that shall contain the training schedule needs for a management cycle.
Verified Document	Document that was evaluated in terms of requirement compliance by the defined evaluation level.

Table 41 descriptions provide a first approach to the development with more detail of the Information Architecture that will be held in paragraph 6.. In the following paragraph 5.2 it will be described how level 2 processes interact taking as base the level 3 BPMN processes designed from the figure 31 to figure 58. This will then enable the flowing up top processes architecture structure.

5.2. CAMO PROCESSES LEVEL 2 ARCHITECTURE

After designing each level 3 process through BPMN, it was possible to established and design how these processes interact. The next figure shows how the processes from Strategic Management level 1 process interact internally other level 1 processes or with external entities.

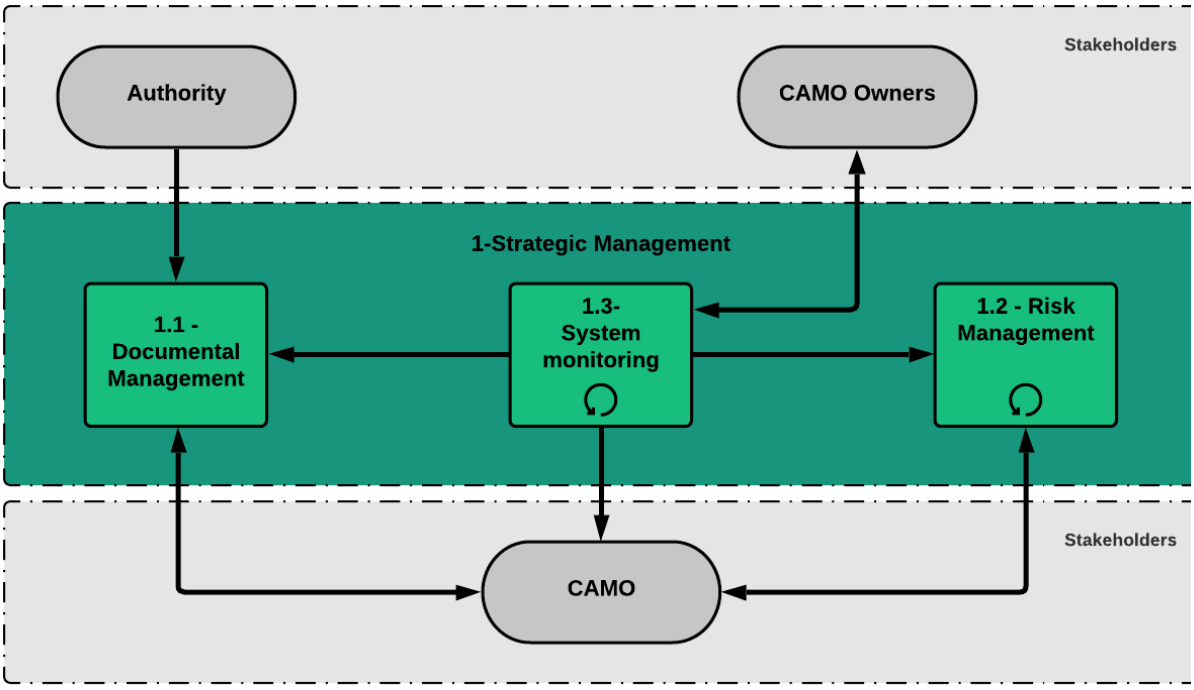


Figure 18 - Strategic Management Process Architecture

The Strategic Management level 1 process includes the processes where management information like the policy, objectives, procedures, actions are determined, controlled and updated with the flexibility that is required to have to adapt to external changes. This allows CAMO has an all, to operate as required and accomplish their goals. In figure 18 is possible to understand how the processes interact with each other. The Documental Management process is where all the organization documentation and internal regulation is made. It can be triggered by any CAMO internal determined requirement, by an improvement proposal or by a Competent Authority requirement required due to a regulation update or determination. These changes may affect the CAMO management system processes or the personnel activities.

The other level 2 process within the Strategic Management process is the Risk Management process which is a specific SMS process. This process is a continuous process and shall be supplied by all the information produced through the CAMO processes. According with the requirements this process shall be specifically triggered during the contracting of Maintenance service or the subcontracting of any CAMO activity as a subprocess (designed in BPM level 3). However, any process or internal responsible can request a risk update if any issue happens that justify that situation. Risk Management is an organizational process that shall be cycling revised and shall be aligned with the goals and organizational actions defined during the System Monitoring.

The System Monitoring process is a management cycle process that provides the systematic way to checks the CAMO performance at the different organizational levels. All the data produced by

all the CAMO processes shall be used to produce or update the required key indicators, so the decision makers can redefine organizational objectives and orientations at strategic, operational and tactical level as required. In the CAMO requirements there is no specific requirement related with the client management, marketing or budget. Accordingly, with requirement CAMO.A.305 (a) only says that “the accountable manger as the responsibility to guarantee that all the resources, namely the financial are available so that the CAMO can accomplish their mission”. For that reason, no client, marketing or budget processes were considered during this CAMO process design, however it can be evaluated if they could be held within the Strategic Management scope.

The input and output resulting in the interface between the Strategic Management processes, the other CAMO processes and the stakeholders are defined in the level 3 SICOP tables from table 13 to table 15.

In the next figure is possible to verify the Compliance Management processes architecture interaction proposal:

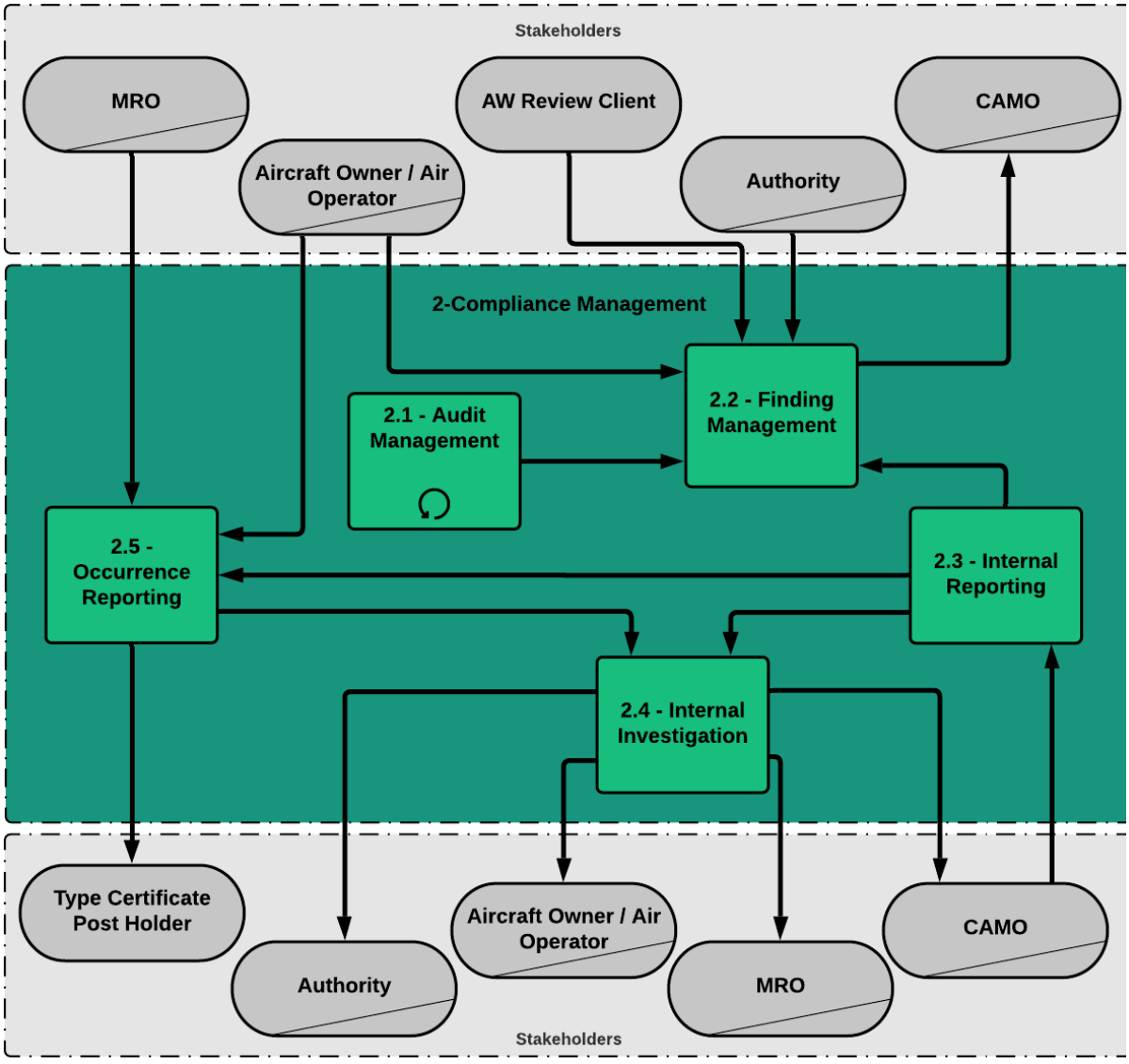


Figure 19 - Compliance Management Process Architecture

The Compliance Management level 1 process contains the processes that interact with each other to verify the system compliance with the defined requirements. Within this process are also defined the necessary tasks to analyze the identified noncompliance findings causes and implement the required actions.

The Audit Management process is a systematic approach to guarantee the audit realization. This will lead to a continuous verification of the system in the different structure areas depending how the organizational structure is organized. The result of the audit process can lead to the identification of findings that must be analyzed by the specific audited area to identify causes and corrective actions to be developed to avoid unwanted recurrences. These analyses and actions are defined in the Finding Management process.

The Finding Management process beyond the finding treatment of the Audit Management process, is also used to treat the finding coming from an internal report that can be made by any CAMO personnel, from the external audits developed by the Competent Authority or by any client (e.g., Operator or Airworthiness Review client). The Finding Management process goal is the same whatever has triggered the process, that is identify the finding causes and establish the required actions measures to eliminate that causes.

The Internal Reporting process is also within the SMS specified activities, where all the CAMO intervenient and personnel are called to report any issue found that could lead to a safety problem. Depending on the report scope this can lead to a Finding Management process, to an Occurrence Reporting or to an Internal Investigation. The Occurrence Reporting shall be done when a safety issue has occurred that impacted in an incident or accident and the Authority and the Type Certificate Holder must be informed. The primary source of an occurrence report can be internal, from the client or from the MRO.

With an occurrence report an Internal Investigation shall be developed. The Internal Investigation can also be needed if the report is considered relevant enough but still having lack of information to be checked. The results of an Internal Investigation shall be communicated to the client, to the authority or to the MRO as required. The investigation results shall also be communicated to or through the CAMO personnel.

The input and output resulting in the interface between the Compliance Management processes, the other CAMO processes and the stakeholders are defined in the level 3 SICOP tables established from the table 16 to table 20.

The next architecture is relative to the Aircraft Management process:

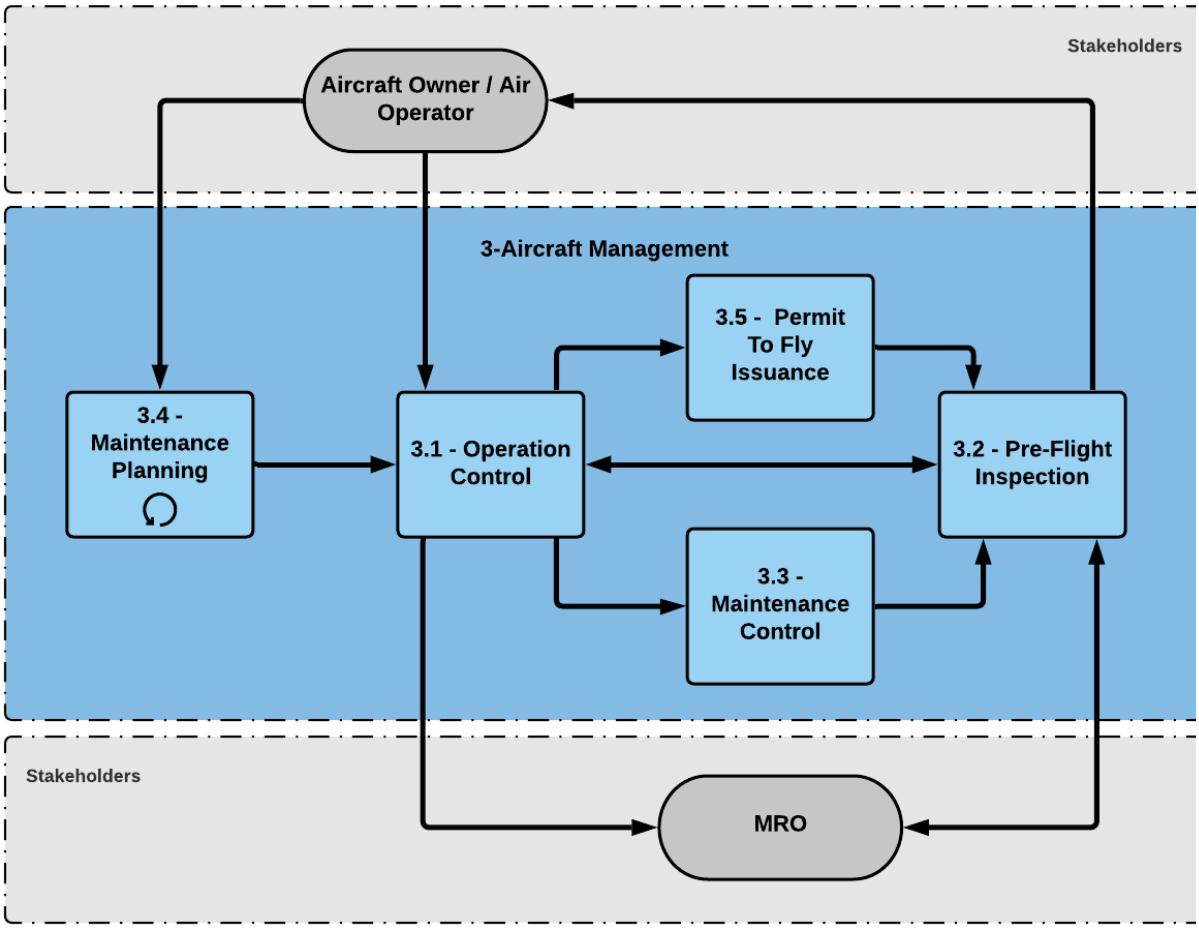


Figure 20 - Aircraft Management Process Architecture

The Aircraft Management level 1 process provides the core processes that allows the direct aircraft airworthiness control through the Operational Control, the Maintenance Control and the Pre-Flight Inspection processes supported by the Maintenance Planning process. It also shall include the Permit to Fly Issuance which is a process to be active if necessary and accordingly with CAMO privileges scope.

Maintenance Planning is the beginning process where shall be developed the document that guides the day-by-day Operation Control, namely the maintenance plan. This document shall be developed with necessary alignment with the information coming from the System Monitoring process (CAMO goals) and the client requirements (operational needs). This information is analyzed and assembled to provide the most optimized maintenance plan possible complying with the AMP established. During this process, the contracted MRO shall be also involved to guarantee the availability and capacity as required. If necessary, a new maintenance provider shall be procured and contracted to provide the necessary aircraft maintenance. The Maintenance Planning process shall be a cycling process that shall by continuously monitored and the plan adjusted as necessary. So being, the Maintenance Planning process shall provide the maintenance requirements that allow the necessary MRO procurement if required. The maintenance plan will provide the necessary information guide so that the Operation Control may not only follow the aircraft operation needs but also daily monitor the compliance of the required maintenance updating the plan as necessary.

The Operation Control is the core of Aircraft management. This process receives the operation report mission feedback through the aircraft logs and then all the aircraft airworthiness data shall be updated. After the verification of that logs, if any maintenance is required the aircraft is considered temporally not airworthy until the maintenance is performed with the CRS issuance. Alternatively, there are specific maintenance needed resulting from deficiencies reported that can be deferred is applicable. This analysis shall be done after updating the airworthiness data to check which maintenance is needed. The maintenance needed can be a schedule (coming from the maintenance plan) or unscheduled maintenance (any deficiency reported by the operation or by the pre-flight technicians). It's in this sequence that there are deficiencies that can be deferred by the proper engineering level (if necessary, it can be required the help of a type certification holder or to DOA), however the majority shall be subjected to a maintenance corrective intervention. If a maintenance is needed the aircraft shall be induced to maintenance, where the complexity of this task will depend on the intervention level needed. In this case, CAMO shall issue the maintenance work orders request to the MRO. The aircraft will then maintain a not airworthy status and is delivered for the MRO to intervention. At same time the Maintenance Control shall be triggered to follow and control the MRO to guarantee that all the required maintenance tasks are performed accordingly. In Operation Control process, if no maintenance is needed or if the reported deficiencies are deferred (must be eligible to be deferred, namely they can’t have impact on safety), the aircraft shall carry on to Pre-Flight Inspection.

For any reason if the aircraft doesn’t comply the necessary established airworthiness requirements but it’s still fit to fly under determined operational conditions a permit to fly can be requested if necessary to proceed to the flight. In this case a Permit to Fly process shall be started and the tasks shall be performed according with level of privileges that CAMO holds. Only authorized Permit to fly personnel can issue this permission. If CAMO has not these privileges it may request to the Competent Authority. If the permission is conceded, the aircraft is ready to the pre-flight tasks and then to the flight under approved conditions. Is important to have in attention that the Permit to Fly process only can be considered in defined specific situations.

As mentioned, during the maintenance some deferments may occur. In Maintenance Control process this will treated likewise in the Operation Control process by the Engineering support level. If needed, a Type Certificate Post Holder or a DOA organization can be requested to support in the decision. After maintenance, MRO is responsible to supply Maintenance Control with all the necessary records that supports and confirms the maintenance performed. MRO also issue the CRS necessary so that the Aircraft is returned to airworthiness condition. After the any maintenance being accomplished the aircraft is ready to Pre-Flight Inspection. If any issue is detected during the Pre-Flight Inspection process, MRO can be requested to intervene. If the maintenance to be performed request a more complex intervention, may be necessary to induce again to the MRO. In this case all data shall be once again updated through the Operation Control process. In case of the Pre-Flight process doesn’t identify any issue requiring intervention, the aircraft is considered fit to fly and it can proceed to the required flight by the operational entity. For the Aircraft Management process, the input and output interface between this processes, the other CAMO processes are defined in the level 3 SICOP tables established from the table 21 to table 25.

The aircraft management process only can be held if the management airworthiness data maintains the applicable data updated. The following figure shows this process architecture:

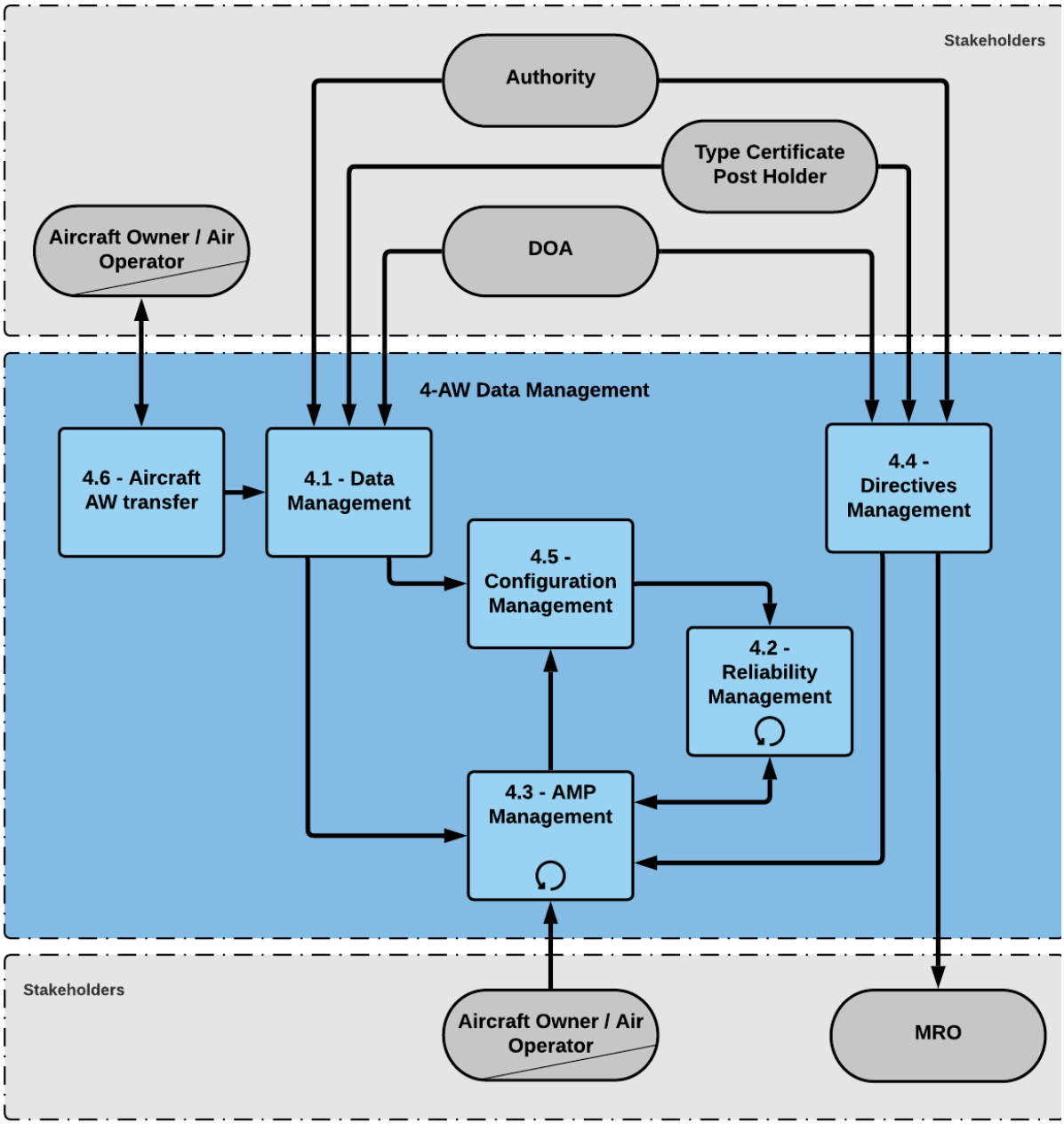


Figure 21 - Airworthiness Data Management Process Architecture

The Airworthiness Data Management is the top level 1 process that has the objective of define and maintain updated the necessary data that establish the aircraft configuration bases and the maintenance instructions required to be controlled within the Aircraft Management and accomplishment by an MRO to guarantee the aircraft airworthiness. The first process from is macro process is the Aircraft Airworthiness transfer process once is the beginning of the aircraft acceptance by the CAMO. This process receives the airworthiness data transferred from the last airworthiness management responsible to be evaluated its compliance. The aircraft have different ways of treatment depending on if it's new or if it came from an EU member CAMO or not. During this process an Airworthiness Review Certificate can be requested if necessary and accordingly with CAMO privileges. In the end, it will also be necessary to request a new Airworthiness Certificate to the Competent Authority. Only after this Certificate being issued it's possible to start the aircraft operation.

After the Aircraft Operation it's necessary to manage the aircraft data. This is made through the Data Management process which the objective is to ensure that the applicable aircraft technical data is always updated and available to the CAMO personnel. This requires the data evaluation by the Airworthiness level responsible. The data can be provided by a Competent Authority, the Type Certificate Post Holder or by a DOA. The data update can induct a configuration management update or an AMP update depending on the data scope.

The Configuration Management process implies the identification of all the aircraft components, system, equipment's applicable as well as the definition of the applicable time limit applicable and how it shall be controlled to maintain the aircraft airworthy. Within this process CAMO shall define the Minimum Equipment List that must be approved by the Authority as well shall define the Mission Equipment List necessary so that the aircraft can operate to a specific mission. The configuration management of the aircraft can be changed and updated due to the updated data available and due to the AMP update.

In the AMP Management process are defined the tasks to maintain updated the AMP which is core document of the airworthiness data to be applied and maintain the aircraft airworthy according with the technical requirements. The AMP is a document that contains the information from the applicable stakeholders in a systematic approach, applicable to the type of operation and purpose of that specific aircraft. This means that to develop AMP it's necessary to also receive operational requirements to maintain the effectiveness of the document. So being, this document defines all the necessary maintenance required to keep the aircraft operating in safe condition. AMP Management shall be a cycle process that must be continuous monitor any necessary data update. The AMP may be necessary to be approved by the Competent Authority depending on CAMO privileges.

Supplementary to the AMP Management process a Reliability Management process may occur, being mandatory for complex aircraft. This process is based on a reliability program that should be continuously updated and shall be aligned with the approved AMP but also with the aircraft configuration. In fact, the Reliability Management process shall generate the necessary information that keeps AMP the most effective and efficient possible. If there is an AMP update, it can also promote updates to the reliability program.

Other documents that can promote an AMP update are safety directives issued by the Competent Authority or by EASA itself, that have airworthiness impact and shall have a quick response from the CAMO. This type of document includes, Airworthiness Directive (AD), Operational Directives with continuing airworthiness impact or other continuing airworthiness and safety problem measures required by the Competent Authority. For this type of issued document, CAMO shall have an immediate response for that issued Directives if they are applicable to CAMO scope. This means that they are differently treated and controlled until enroll in the AMP if required. The process to achieve this goal is the Directive Management process. This shall receive these issued documents from the Competent Authority (including EASA), by the Type Certificate Post Holder or by a DOA. This type of documents shall be immediately updated in the Airworthiness Control Data System and shall be communicated to MRO to guarantee the necessary level of accomplishment. For the Aircraft Data Management process, the input and output interface between this processes, the other CAMO processes are defined in the level 3 SICOP tables established from table 26 to table 31.

To guarantee the necessary airworthiness control of the aircraft, the Part-CAMO requirements establish the need of each aircraft being subjected to a periodic Airworthiness Review so that can be issued an Airworthiness Review Certificate that is the document that guarantees the validity of the Airworthiness Certificate and proves the aircraft continued airworthy. The following process defines how the CAMO may perform those tasks.

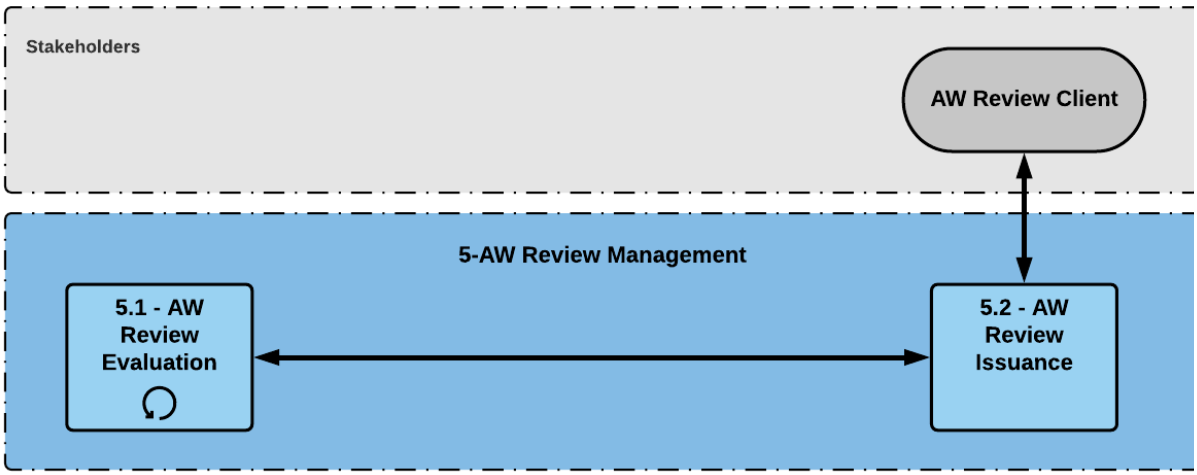


Figure 22 - Airworthiness Review Management Process Architecture

The figure 22 scheme shows the Airworthiness Review Management level 1 process. This process is composed by the Airworthiness Review Evaluation and by the Airworthiness Review Issuance. The first process contains the necessary tasks to evaluate the need of the airworthiness review depending on CAMO privileges and how the aircraft has been controlled in the previous 12 months. Depending on the aircraft type and CAMO privileges it can be required an Airworthiness Review Certificate issuance, or the validation date of the certificate can be extended until 2 times after the first certificate issuance. The certificate or the extension can be issued either by a responsible CAMO with those privileges, by the authority or by a subcontracted CAMO with privileges to do it. If CAMO has Airworthiness Review privileges or need to proceed for a recommendation (applicable for some type of aircrafts), the Airworthiness Review Issuance process shall be activated. This process can also be activated by the aircraft airworthiness transfer process if an AW Review Certificate is needed to be issued.

The Airworthiness Review Issuance process contains the tasks to be done by the airworthiness level and by the airworthiness review staff so that they can issue or recommend the airworthiness review certificate issuance if all the requirements are met. The final output of this process is the airworthiness review certificate renewal by the CAMO or by the Authority as required. This process can be subcontracted by another CAMO, a CAO or Part ML organization that doesn't have Airworthiness Review privileges. The SIPOC table 32 and table 33 contains the information of the process's boundaries.

To carry out all the required activities to be performed in a CAMO, it's necessary highly qualified personnel. The requirements establish the necessary tasks to plan, evaluate and control the Human Resources in terms of quantity and qualifications to be held and maintained. The following figure shows the Human Resources Management level 1 process:

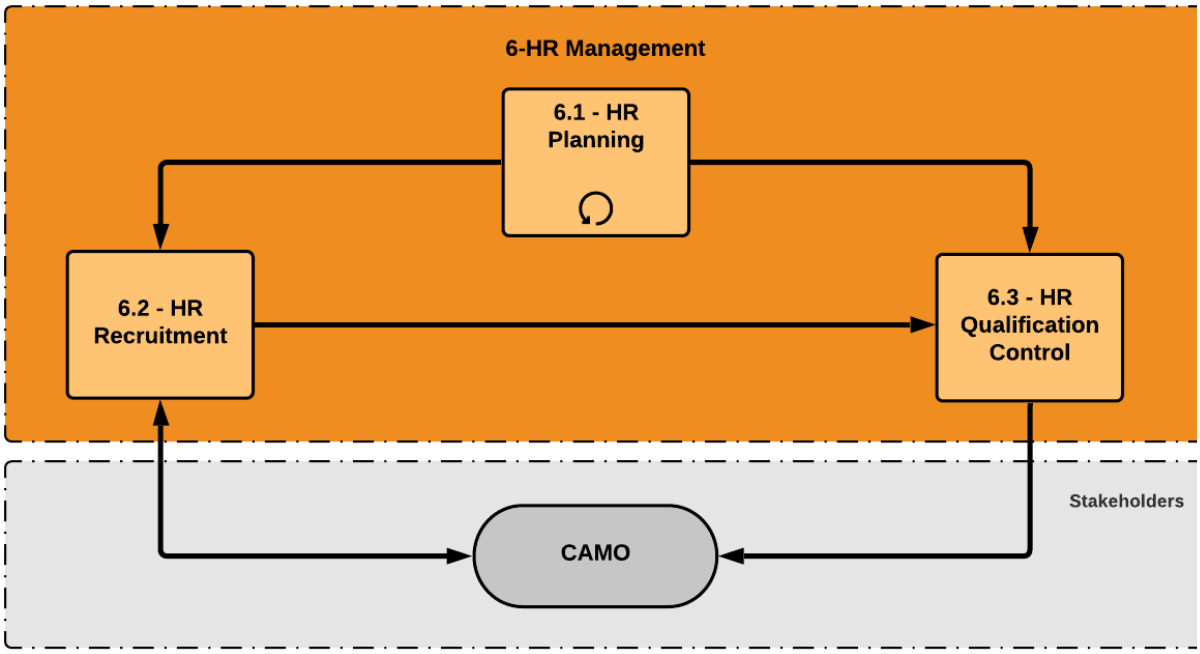


Figure 23 - Human Resources Management Process Architecture

The Human Resources Management Process contains the Human Resources Planning which is a cycling process that allows the development of Human Resources hiring plan but also the Human Resources training plan. These plans shall be designed and continuously updated. The elaboration of this plans depends on the evaluation of the job description requirements, the personnel performance and the volume of CAMO work to fulfill the established objectives.

With the established hiring plan, the Human Resources recruitment shall be triggered to recruit the personnel that holds the necessary requirements for the job. In some situation, due to the job specifications, that requires CAMO internal training or specific formation that CAMO may contract to guarantee the personnel acceptance by Competent Authority if required. This shall be done before the final hiring subprocess. In the end of the process the training plan may be updated to contain the necessary continuous training necessary to maintain all the hired personnel qualified. This process can also be activated in case of not planned hiring necessity is identified by any CAMO internal stakeholders (e.g., if a key person leaves CAMO).

Finally, the HR Qualification control is a continuous process that is activated always that a qualification is near to be expired or its necessary to fulfill a planned training. This process aims to guarantee that the necessary training (given internally or contracted externally) is carry out so that the personnel can maintain their qualifications. The Human Resources Management level 2 processes inputs and outputs are defined from SIPOC table 34 to table 36.

Another support level 1 process established was the Facility Management process. This is a very particular process that leads with the necessity of maintaining the facilities management adequate to perform CAMO activities.

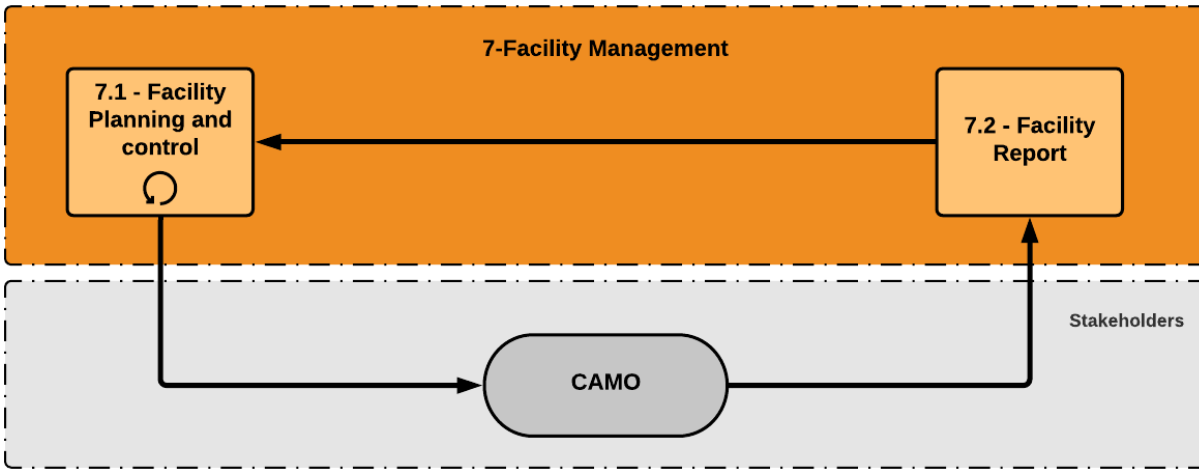


Figure 24 - Facility Management Process Architecture

The Facility Management process is composed by 2 processes. The first process is the Facility Planning and Control process that is composed by the necessary tasks to plan the facility requirements accomplishment during a specified management cycle. These requirements shall trigger as necessary the contract/subcontract process to procure the facility service provider to meet the identified needs. The implementation of these requirements shall be controlled to guarantee that accomplishment.

The second process is the Facility Report process where all the CAMO operational areas can report any issue related to facilities that doesn't guarantee the fulfillment of CAMO tasks in the specified conditions. This process was designed to promote the necessary update to be held in the facility planning. If a noncompliance urgent situation is reported the process is prepared to support an immediate response. In SIPOC table 38 and table 39 are defined the boundaries of these processes. The last proposal level 1 support process is the Procurement Management architecture. This level 1 process is composed by the follwing arquitecture as follows:

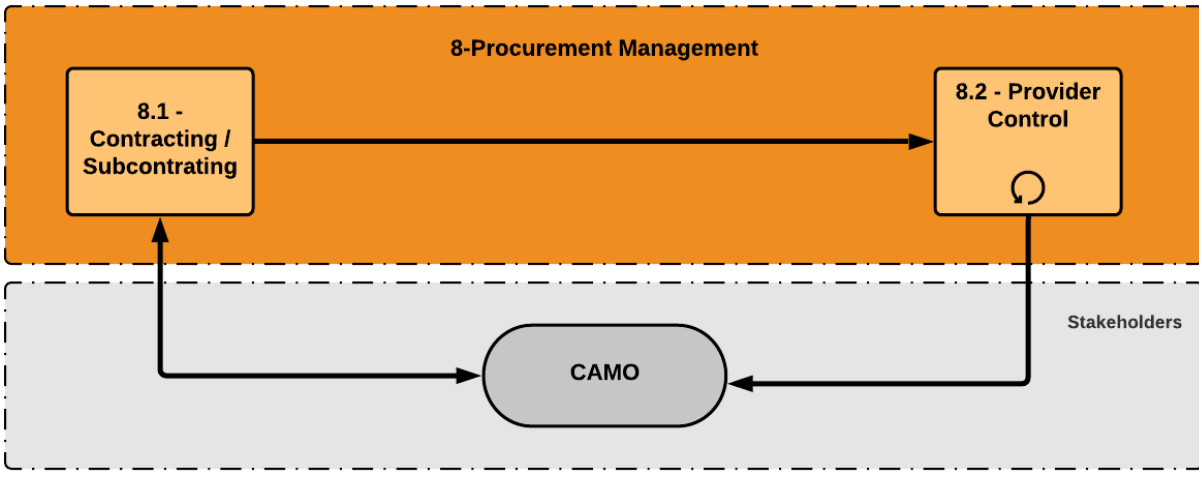


Figure 25 - Procurement Management Process Architecture

As is possible to verify in figure 25, Procurement Management process proposal is composed by the Contracting/Subcontracting process and by the Provider Control process. The Contracting/Subcontracting shall be started with the definition of the Service or Product requirements

to fulfill the CAMO needs in terms of contracting or subcontracting. This can be required by any need CAMO area, however, has a direct relation with Maintenance Planning, Facility Planning and Control, Human Resources Recruitment and Human Resources Qualification Control processes once it can be activated as subprocess if necessary.

In the Contracting/Subcontracting process are defined the necessary tasks to hire a service or to buy a product that enables to develop the CAMO functions. This process purposes 3 types of procedures to hire a service/product provider. These procedures are the provider invite, service proposal request (direct purchase) or the through public offer requirement. If a CAMO subcontracting service or MRO service is required, a Risk Management process shall be activated. The final product of this process is the establishment of a contract or the purchase order to the select service or product provider.

After the service or product provider being selected, the Provider Control process shall be activated. This process has the objective to guarantee that the provider fulfills the contract or the purchase order that has been established but also evaluate the service provided to future interactions. If any deviation is found a mitigation plan and action shall be guaranteed. In case of the provider is a MRO or a subcontracted CAMO, this shall generate the Risk Management update. The Provider Control process is a continuous process to be developed until the service or product is provided. The Procurement Management Process is an essential key in the CAMO processes and the framework of this processes were described in SIPOC table 39 and table 40.

In the next paragraph it will be discussed and integrated all these processes architectures and the level 1 top process architecture will be design.

5.3. CAMO PROCESSES LEVEL 1 ARCHITECTURE

In the previous paragraphs was analyzed the CAMO requirements which abled to identify different processes, at different architectural levels. It was also possible to identify the stakeholders that interact with the CAMO and the different levels of responsibility to develop the processes tasks. With this information was possible to design lower-level processes, using BPMN which helped to better understand how the processes and the stakeholders shall relate in terms of information exchange.

To develop the top CAMO architecture proposal was then used all the generated information throughout this work. The level 1 architecture integrates the level 2 and level 3 architectures design in a top high-level approach that allows to oversee how the top processes interact with each other and with the stakeholders. The following figure exposes the architectural configuration proposal:

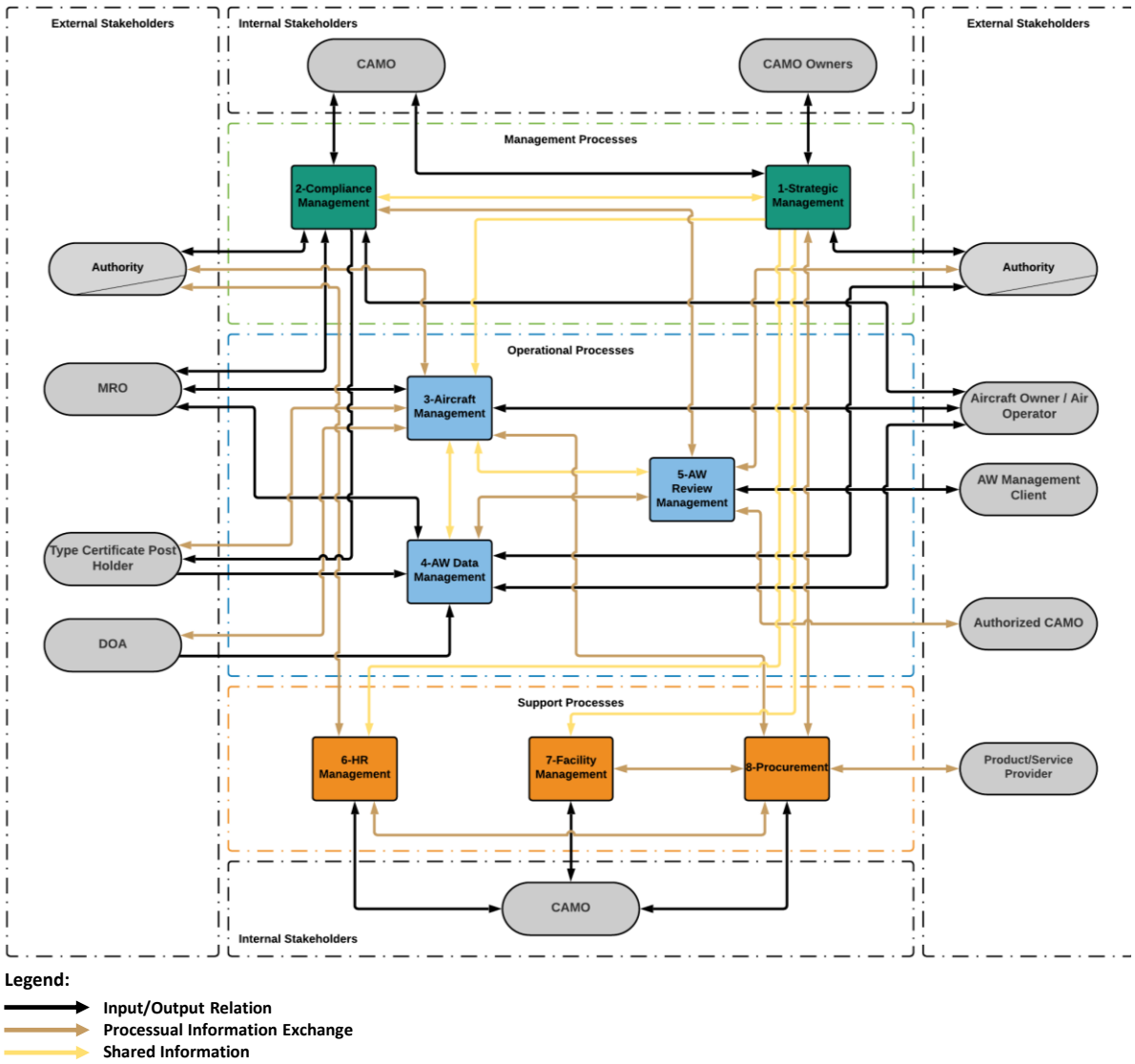


Figure 26 - Top level CAMO architecture proposal

In figure 26 it's possible to verify all the level 1 processes and the stakeholders that were identified already in figure 15. However, after the CAMO requirement analyses and the TOP-DOWN-TOP continuous approach was possible to design how these processes relate and share information, achieving the proposal architecture. In order to have a clearer view of this design proposal, stakeholders were divided in 2 types:

- The internal stakeholders composed by CAMO (related to all CAMO processes and personnel) and CAMO owners.
- The external stakeholder composed by the external entities that doesn't belong to the CAMO structure identified in table 9.

In this figure were considerer 3 types of processual relationships being used 3 different line color to represent them: the black, the brown and the yellow line. The black lines means that between the CAMO internal processes or between the CAMO processes and the stakeholders there are at least an input/output relationship. This means that within the processes there is at least an input/output information exchange that ends a CAMO process that begins another process, an action developed by

the Stakeholder that activates a CAMO process or the reverse, that is the Stakeholder issue some information, action or request that triggers a CAMO process to deliver something.

The brown line means that at some point within the considered process there is an information required from some stakeholder or process, but the process doesn't end until that information is returned. For example, a documental approval or certificate issue from some entity that often requires CAMO tasks to finalize the process after that being issued.

For last, the yellow lines means that some process produce some information that is used in some point in other process, that is, it may call another process as a subprocess. For example, some document is updated throughout the first process, but at some time that information can be used to develop a specific task in a second process but without a process input/output relationship.

Between black, brown, and yellow line it was considered a hierarchical relationship. For the black line it's considered that may include the type of information being trade by the brown and yellow line. For the brown line it's considerer that may include the information being trade like the yellow line.

Looking to figure 26 it's possible to verify that management and support process have information trade with CAMO processes and personnel crosswise. Specifically in Processes Management this happens because this kind of processes uses information from all the internal processes to check the organizational compliance level, to define rules of work and promote overall actions to improve and achieve the desired goals to meet the CAMO objectives. That's why Strategic Management has a connection with CAMO Owners once the organization shall follow the leadership vision, policy and desiderates. The Compliance Management even collects overall reports and occurrences to investigate why those issues happened promoting the necessary actions to avoid findings recurrence.

Beyond internal stakeholders' relations, Management processes have relations with external stakeholders, namely Authority, MRO and the Aircraft Owner/Air Operator. The relation with authority happens because throughout the various processes there are documentation approvals to be requested and reports necessary to be communicate. In other hand, authority may issue any new requirement that promote an organizational change that must be considered at strategic level.

The relation with MRO and Aircraft Owner/Air Operator occurs due to reports that these stakeholders must perform when required but also the communication that they shall receive or participate after the investigations being performed. Many times, these stakeholders must also have to develop internal actions to avoid future incidences.

The only brown line considerer within the management processes scope is a connection with the procurement process. This relation happens because of the obligation to considerer Maintenance Contracts and CAMO subcontracts within organization Risk Management approach.

Moreover, within the Strategic Management process boundaries, is possible to verify three yellow lines. The connection with the Strategic Management processes occurs because this process generates information that is used by compliance processes to check the compliance (organizational procedures for example), but also the reverse. Strategic Management shall use the compliance data to evaluate the compliance performance and define higher levels of safety goals. For that it can be used reports and findings records to define new lines of action, changing procedures or improve the hierarchical structure through the organization. Although this process generates the strategic lines to all CAMO

process operation, it has a specific impact in the planning process, namely in the Aircraft Management, Human Resources Management and in the Facility Management.

To maintain the aircraft airworthy, the identified operational processes need a continuous trade of information between each other, but also between the stakeholders. Aircraft Management process holds an input/output information relation with MRO and with Aircraft Owner/Air Operator once this process that makes the bridge between the operational needs and the aircraft maintenance required to guarantee the aircraft airworthiness. It's through this process that the aircraft is received from the operation, mission records are updated and analyzed, are verified maintenance needs, and the aircraft is induced to maintenance if required. This process shall guarantee that the aircraft is only returned to the operator if everything is done accordingly with the requirements. During this process many information exchanges can be necessary. It starts with Maintenance Planning, where it's necessary to guarantee that there is an MRO that shall accomplish the necessary requirements to accomplish the maintenance needs. It's due to this need that there is a brown connection between Aircraft Management process and Procurement Management process.

In other hand if any deficiency is identified it can be necessary to require technical support with a DOA or with the Type Certificate Holder. If a Permit to Fly is necessary to be issued, it may be necessary to request Authority approval. This is only possible to be performed with the Airworthiness Data Management data produced in terms of configuration, established AMP, but also the definition of the Directives to be accomplished during these processes. It's also important to guarantee that Airworthiness Review Certificate maintains its validity to be authorized to fly.

The Airworthiness Data Management is the process that receives the external data that come from DOA, the Type Certificate Holder, the Aircraft Operator or from the Competent Authority to be analyzed so the AMP can be develop and maintained update as necessary. This will able the Aircraft Management process to ensure the aircraft airworthy. During Airworthiness Data Management process a new aircraft in CAMO scope can be received. Within these tasks it may be necessary to request the Airworthiness Review Management process to guarantee that the aircraft is airworthy.

The Airworthiness Data Management process also exchanges information with the Authority once there are documents that may be necessary to be approved by that entity namely the AMP and the MEL, but also because an aircraft Airworthiness Certificate can be necessary to be requested during the aircraft transfer to the new CAMO. This process uses the Aircraft Management and Airworthiness Review Management records to guarantee continuous analyses of the aircraft data and maintain the AMP updated, efficient and effective in accordance with the organization goals and levels of safety required. This shall be guaranteed by AMP continuous evaluation but also by the reliability necessary process.

The Airworthiness Review Management is a continuous level 1 process which the review tasks can be subcontracted by an Airworthiness Management client (other CAMO, or CAO, or other). In other perspective and depending on the CAMO privileges it may be also required a subcontracting of another CAMO to perform this task. For instance, if a CAMO has not Airworthiness Review privileges for one specific type of aircraft it may need to contract an authorized CAMO who have these privileges or else it may also require Authority intervention. In some situations, it's mandatory CAMO provide an Airworthiness Review Recommendation so that Authority may issue the Airworthiness Review Certificate. Airworthiness Review process uses the Airworthiness data and Airworthiness records

generated during the aircraft life to make a deeper and cyclical compliance assessment to guarantee safety compliance. Nevertheless, this process can trigger the Finding Management process to request the treatment and resolution of any deviation found. The Airworthiness Review Certificate can't be revalidated if any deficiency found during the Airworthiness Review tasks remains open.

Support processes also have CAMO overall impact once this are processes with the necessary and defined activities that have the goal to develop the necessary conditions to a CAMO fulfill their purpose. Any of the 3 top level support processes needs the CAMO requirements and inputs so they can develop the necessary action to recruit new human resources as necessary, but also maintaining all the personnel qualifications, and the necessary facilities according with required requirements. The support processes also contain the necessary activities to procure and contract the best services and products so that CAMO can provide the better service possible.

Is possible to observe that Procurement Management has a relation with an external stakeholder, namely the Product/Service Provider. This is due to the necessary information exchange during the contact/subcontract process to guarantee the requirement accomplishment. This process also maintains an information exchange with Human Resources management and with Facility Management. This happens because of the necessary services that may be necessary to be contracted, in particularly to external training or facility services hiring. As mentioned before, Procurement Management process must have an informational relation with Aircraft Management process, namely when maintenance planning is established. This relationship arises from the need to guarantee that the maintenance services are contracted as required. It's also necessary to guarantee the Strategic Management relation once it's necessary to include MRO contract or CAMO subcontract is included in the Risk Management organizational program.

After designing the different process architecture levels and have a first approach where were identified the necessary data to be collected or generated, it's possible to propose a CAMO Information Architecture high level approach. This will be discussed in the following paragraph.

6. CAMO INFORMATION ARCHITECTURE

6.1. INFORMATION ARCHITECTURE VIEW DESIGN

Another way to have the view of organizational flow is through its information architecture. The objective of this chapter is to design and propose a high-level informational model that help to clarify what information is necessary to CAMO perform its goal and how this information flows through the organization processes. So being, to begin the development of the information architecture it's necessary to identify with the information groups are required.

The BPMN developed process delivers a fundamental help in this feature. Throughout the process design were identified data objects where the information shell be contained. This data objects were identified in table 41. So being and to have a clearer view of the information storage or document required, it had been developed a matrix that helps to understand when each process interacts with the identified system or document, where "system" means a data or records repository in structured form as defined before. This matrix can be analyzed in appendix figure 59. From this figure is possible to see in left side with dark grey top label the objects identified as system. In the right side with light grey top label are identified the main documents that are used during the processes. Comparing figure 59 with table 41 the object identified has "Management System" has been exchanged and unmultiplied by all the CAMO identified systems. The processes which require this information are typical top management processes that needs integrated data from all CAMO processes to determine decisions and orientations or, in other hand, to check management system compliance. In this matrix the object "management system" from table 41 was then not considered. In fact, the processes that used this object in BPMN design were cross checked with all the identified information systems. So being, figure 59 shows in a clear form the information needs required throughout the processes.

Using a cycling approach, based in the level 2 processes architecture (figure 18 to figure 25), the level 1 architecture design (figure 26) and the figure 59 crosscheck identified information required, was possible to design and propose the Information Architecture view. For this was used 3 levels of Data Flow Diagrams (DFD). The first level designed was level 0 with the overall CAMO management system output/input flow system proposal. In the following figure shows this proposal where is possible to check the identified information that shall be exchange between CAMO and the stakeholders:

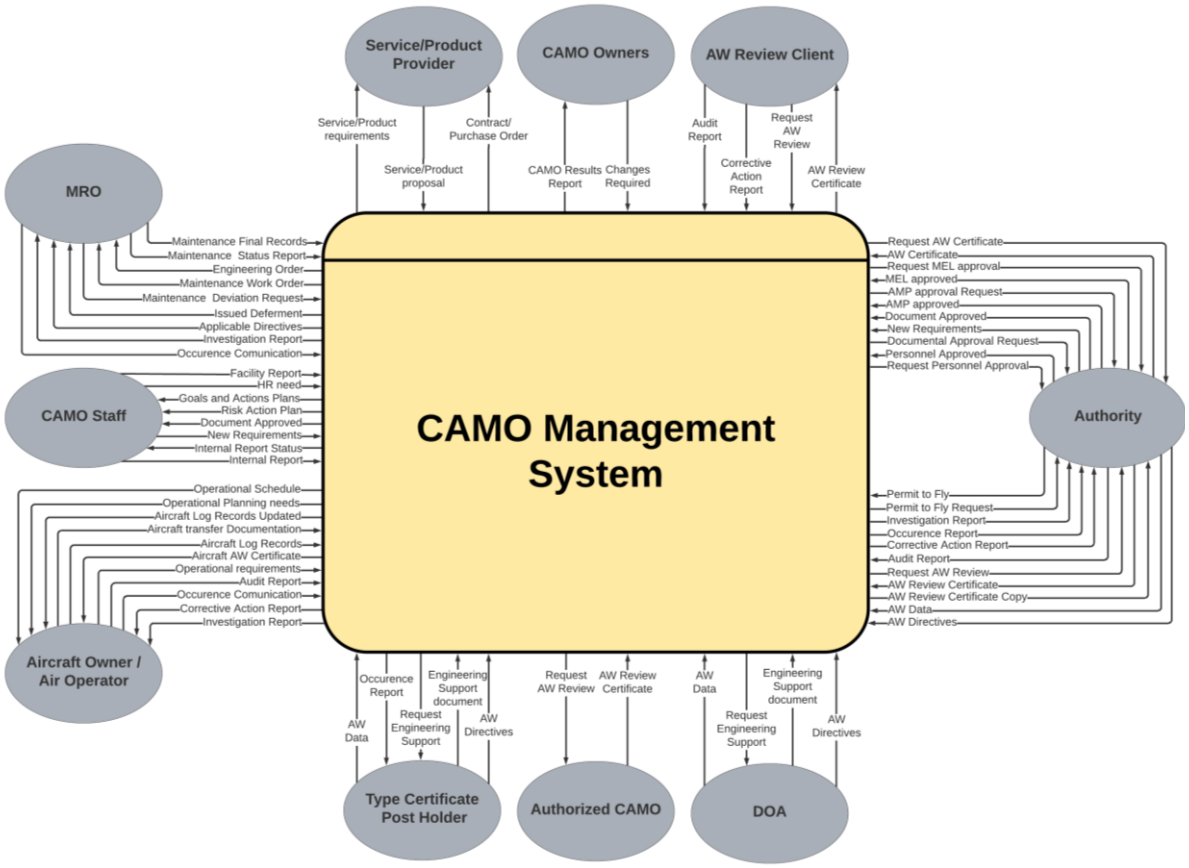


Figure 27 - Information Architecture DFD/level 0

Figure 27 illustrates the top information architecture that shows how the documents, reports, requests or communications shall be exchanged between CAMO and the stakeholders. Some of these documents have specific forms that are established in the regulation, but others don't have any specific form. The documental exchange mechanism is not also defined, it will depend on the contract established with the Service/Product Providers or how the Competent Authorities determines that method of communication. In this architecture was necessary to redefine CAMO entity, used has a generic entity during process design, as a more specific entity, changing their scope. It was used "CAMO Staff" instead which abled to have a clearer information flow view and architecture structure. This entity was used when any CAMO personnel may perform the reports to the CAMO responsible or in other hand can receive any kind of orientation order or rule that they must comply.

By clicking on figure 27 it's possible to flow down to DFD level 1 design that is established in

figure 60. This figure shows the information model how the level 1 processes interact. Naturally the identified processes are the same as previous identified in paragraph 4.1. In

figure 60 is possible to check the data objects identified in table 41 and reorganized in figure 16 and the way they shall interact with each other. It shows all the interactions and information flow and necessary repositories that shall be held to guarantee documentation required information.

Flowing down the architecture and to have a deeper information analysis, it was design DFD level 2 that can be achieved by clicking in

figure 60 processes. This makes possible for each of these processes be flow down to the lower architecture level that helps to understand how the level 2 processes exchange information. Each of these architectures is aligned with the processes identified in the previous paragraphs of this work. This completes the CAMO needs through the information flow proposal. The identified information identities will have a deeper analysis and high-level description on the following paragraph.

6.2. HIGH LEVEL INFORMATIONAL ENTITIES

To have a clearer perspective from the information required it's important to define the informational entities identified before. In the previous chapter was possible to have the view of the high-level type of information needed and how that information shall interact with the processes and with all the involved entities. Having the CAMO requirements and respective AMC as base it's possible to have general idea of the entities required to fulfill CAMO needs. Although each organization shall tailor the information required according to each reality, it's possible to have a high-level approach where the main information can be defined.

Throughout the Continuing Airworthiness Regulation (EU) No 1321/2014 it's possible to verify references to the need of keeping records of the developed CAMO activities. However, the requirement CAMO.A.220 Record-Keeping has a specific weight in this point. According with this requirement CAMO shall maintain continuing airworthiness management records that includes:

- The aircraft technical log system;
- The works carried out;
- The documentation issued by the CAMO (supporting documents, certificates, recommendations);
- The management records developed through the activities carried out in accordance with CAMO privileges;
- Contracts and Subcontracts records;
- Personnel records.

The identified informational entities shall be aligned with these requirements and shall maintain all the necessary data and records that helps CAMO to achieve their objectives, to maintain the requirements compliance, to evidence all the performed tasks that assure an organizational safety approach. Within this scope the following table resumes the information required for each data entity identified.

Table 42 - Informational Entities description

Informational Entity	Description
D1 - Document Management System ▪ Documents development and control • CAME • Policy	According with CAMO.A.200 - "Management system", "the organization shall establish, implement and maintain documentation of all management system key processes, including a process for making personnel aware of their responsibilities and the procedure for

Informational Entity	Description
• Procedures • Forms • Other organizational documents ▪ Document responsible ▪ Document approval status ▪ Document date approval	amending this documentation". GM1 CAMO.A.200 and AMC1 CAMO.A.200 reenforces which documentation information shall be held. This includes the documentation like the safety policy and objectives and procedures. In CAMO.A.300 - "Continuing airworthiness management exposition" are established the Continuing Airworthiness Management Exposition (CAME) document requirements. This is an essential document that must be controlled and being up to date. So being, the information repository shall have the system documentation that defines CAMO politics and how it works, the responsibilities for each activity and how CAMO fulfill all the regulation requirements.
D2 - Findings Records System ▪ Finding origin ▪ Finding description ▪ Finding responsible ▪ Finding analyses and taken actions ▪ Finding status ▪ Finding date control	CAMO.A.150 - "Finding" defines the requirements how findings shall be managed. According with CAMO.A.150(a) is necessary to define root cause, the corrective action plan to eliminate findings source. These actions shall be performed in a period agreed with the Competent Authority. So being there shall exists a repository that contain the records necessary to guarantee this control and maintain a historical log in other to evidence this approach. The finding record system shall have the origin of the findings keeping the treatment records, and where did it come from (an internal or external audit or from a report).
D3 - Risk Management System ▪ Hazards identification ▪ Risk assessments ▪ Risk evaluation ▪ Risk responsible ▪ Risk status ▪ Actions taken	GM1 CAMO.A.200 - "Management system" defines that "safety management seeks to proactively identify hazards and to mitigate the related safety risks before they result in aviation accidents and incidents". So being, risk processes defined in CAMO.A.200 defines that hazard shall be identified and risks shall be analyzed and evaluated in terms of severity and probability, assessed and controlled in terms of mitigation in accordance with AMC1 CAMO.A.200(a)(3). All these actions shall be recorded and updated as necessary. This information shall follow CAMO daily evolution in terms of actions taken and new data updates. This shall enable CAMO to manage its activities in a more systematic and focused manner.
D4 - Management Control System ▪ Management Goals ▪ Key Process Indicators ▪ Required actions and responsibilities	According with CAMO.A.220 - "Record Keeping", CAMO shall maintain the "records of management system key processes as defined in point CAMO.A.200". This means that key processes shall be monitored in terms of performance and effectiveness. GM1 CAMO.A.200 -

Informational Entity	Description
	"Management System" defines the main vectors that should be monitored by the system. CAMO requirements are safety focus, but in this informational approach in can be completed with business management vectors once the activities to be performed can be integrated. In this information repository shall be kept the records all the high-level orientations, the defined goals, the goal responsible and the actions to be taken. This will able the compliance monitoring of the determined actions and goals to be achieved, but also shall lead to a proactive systematic continuous improvement approach.
D5 - Internal Report Record System ▪ Report description ▪ Report Dates and Status ▪ Report treatment definition	According with CAMO.A.202 - "Internal safety", "the organization shall establish an internal safety reporting scheme to enable the collection and evaluation of such occurrences to be reported". AMC1 CAMO.A.202 and GM1 CAMO.A.202 defines the particularities that this system shall have, namely the connection that shall be held to the occurrence report, the finding treatment or the investigation that can be develop after an internal safety report. This information repository was proposed so that any internal stakeholder may report any issue and have the necessary treatment has required. Each report shall be traceable.
D6 - Continuing AW Data System ▪ Aircraft and component identification ▪ Applied Directives • Airworthiness directive (AD) • Operational directive with a continuing airworthiness impact • Continuing airworthiness requirement established by the Agency • Measures required by the Authority in immediate reaction to a safety problem ▪ AW instructions • Instructions issued by the Authority • Instructions for continuing airworthiness issued by the holders of the type certificate,	CAMO.A.325 - "Continuing airworthiness management data" defines that "the Organization shall hold and use applicable current maintenance data […], for the performance of continuing airworthiness tasks". The Continuing Airworthiness Data system shall be the CAMO data repository where are defined all the needed information so that each aircraft can maintain its airworthiness condition. This is the repository where the Aircraft Maintenance Program can be defined in a centralized form to accomplish M.A.302 - "Aircraft maintenance programme", M.A.303 - "Airworthiness directives" and M.A.304 - "Data for modifications and repair". So being this data repository shall contain all technical data that is applied to each aircraft and components, all the directives, the modifications data and the maintenance required. Therefore, this information repository shall also identify each aircraft and respective configuration that the aircraft can hold, the applicable MMEL, MEL and Mission MEL, the applicable component that can installed and each life-limit applied. All this data shall be maintained up to date.

Informational Entity	Description
restricted type certificate, supplemental type certificate, major repair design approval, ETSO authorization or any other relevant approval issued under Annex I (Part-21) to Regulation (EU) No 748/3013 • Instructions for continuing airworthiness included in the certification specifications • Repairs/modification data • Aircraft maintenance manual • Engine overhaul manual • Aircraft illustrated parts catalogue (IPC) • Wiring diagrams • Troubleshooting manual ▪ Configuration Control • Minimum Equipment Lists • Mission Equipment List • Aircraft Applied Configuration (Applied components structure and hierarchy definition) • Applied Parts Identification according to Aircraft Illustrated Parts Catalogue (IPC) ▪ Applied Life Limit measures (Aircraft and Components)	
D7 - Continuing AW Record System ▪ Aircraft and component identification ▪ Aircraft and Components Records Status • Performed Maintenance • Life Limit consumptions and Status • Defects Description and Status • List of Deferred defects and its status • Configuration status and report • Mass and Balance Performed • Modifications performed	According with requirement M.A.305 - "Aircraft continuing airworthiness record system" CAMO shall have a repository of all the aircraft continuing airworthiness records that can show the daily status of each aircraft. GM M.A.305 defines that the record system "are the means to assess the airworthiness status of a product and its components". This system shall contain evidence of all the actions taken in the aircraft and components "to demonstrate that the aircraft is in compliance with the applicable airworthiness requirements" which shall be established on the D6 - "Continuing AW Record System" proposal. The maintenance records include CRS that shall be issued after any maintenance, the total in-service life

Informational Entity	Description
• Maintenance Check flights records • AD/BS accomplished • Certificate of Release to Service control ▪ Aircraft AW Certificates ▪ Aircraft Technical Log System	accumulated for the aircraft, engine(s) and/or propeller(s), the technical log of the aircraft, the mass and balance reports, accomplished modifications, repairs completed and deferred maintenance. GM M.A.305 defines all the detailed records and documentation required that shall feed this information system. In other hand, this system shall also contain all the information from the aircraft technical log system. This means that, beyond the maintenance status (Maintenance performed, deferments and CRS) this system shall contain the information about each flight performed, but also the necessary information to ensure continued flight safety, which will give to operator a resume of the aircraft condition in that moment. M.A.306 Aircraft technical log system and AMC M.A.306 Aircraft technical log system contains the detailed information required.
D8 - Reliability System ▪ Aircraft and Components performance Indicators ▪ Reliability Reports ▪ AMP change proposals	CAMO.A.315 - "Continuing airworthiness management" defines that a CAMO shall "ensure that an aircraft maintenance programme including any applicable reliability programme". According with AMC M.A.302(g) - "Aircraft maintenance programme", "the purpose of a reliability programme is to ensure that the aircraft maintenance programme tasks are effective and their periodicity is adequate" and able the continuous "monitoring the effectiveness of the maintenance programme". This means that reliability program shall continuously be feed by the airworthiness records to continuously update the established indicators so that it is possible to have a real time engineering analyses and better decisions about the AMP effectiveness. The reliability program shall be adequate to the aircraft complexity. The Appendix I to AMC M.A.302 and AMC M.B.301(b) - "Content of the maintenance programme" established the detailed orientation to the reliability program.
D9 - Human Resources System ▪ Job descriptions ▪ Personnel Identification ▪ Personnel qualifications, qualification needs and qualification validation control ▪ Personnel evaluation	CAMO.A.305 - "Personnel requirements" defines that "the Organization shall establish and control the competency of personnel involved in compliance monitoring, safety management, continuing airworthiness management, airworthiness reviews or recommendations and, if applicable, issuing permits to fly". To reenforce this requirement, CAMO.A.220 -

Informational Entity	Description
▪ Training schedule ▪ Training evaluation	"Record-keeping" defines that CAMO must contain the personnel records, namely "records of qualification and experience of personnel involved in continuing airworthiness management, compliance monitoring and safety management" and "records of qualification and experience of all airworthiness review staff, as well as staff issuing recommendations and permits to fly". This means that is necessary to maintain up to date all the personnel records in terms of functions to be performed, qualifications, training and individual performance. AMC1 CAMO.A.220(c)(1)(ii) defines with high detail the data required to control for airworthiness review staff. AMC CAMO.A.305(g) defines that staff must have adequate initial and recurrent training that must be provided and recorded to guarantee that personnel maintain the necessary competences. Although requirements are very detailed to the safety training, is necessary to keep records for all the training obtained by all the CAMO personnel.
D10 - Facility Report System ▪ Facility Report description ▪ Facility requirements ▪ Facility Status	CAMO.A.215 - "Facilities" defines that "the Organization shall provide suitable office accommodation at appropriate locations for the personnel". AMC1 CAMO.A.215 describes that "office accommodation should be such that the incumbents, whether they are continuing airworthiness management, planning, technical records or management system staff, can carry out their designated tasks in a manner that contributes to good standards". Office shall have the necessary conditions in order that any activity task is carried out without disturbance. So being is important to involve all the personnel to report any issue that don't able to perform the required actions.
D11 - Service Provider System ▪ Service/Product Identification ▪ Contract evaluation control ▪ Service/Provider evaluations ▪ Service/Provider Risk Management	According with CAMO.A.220 - "Record-keeping" shall maintain "contracts, both for contracting and subcontracting" that shall be kept for a minimum period of 5 years. According with GM1 CAMO.A.205 - "Contracting and subcontracting", CAMO is responsible to ensure that all tasks and requirements area guaranteed by the service provider. According with this requirement Risk Management shall be included for the contracted service, namely subcontracted tasks and maintenance contracted. This information shall be maintained and a historical log may be created to

Informational Entity	Description
	guarantee the future service acquisition accordingly with the required historical evaluation to be defined.

The requirement CAMO.A.220 - “Record-keeping” establishes the orientations about the way how the information shell be treated during the CAMO processes. All the records shall be easily accessible, traceable and retrievable whenever is necessary to demonstrate any issue. There is no imposition about the way how the records shall be maintained. If it’s used digital information, the CAMO must guarantee systems redundancy and prevent those unauthorized personnel may change any data. The regulation also defines the minimum period to maintain the records. The default period to maintain all records is 3 years, however there are specific requirements that can define a longer period. For example, management system records, the established maintenance contracts or the subcontracted activities shall be maintained along 5 years.

After defining the informational architecture, is important to have clear guideline how technology can help to leverage the identified processes. In the following chapter will discussed how the technology identified in the previous paragraph 3.3 can help to improve the CAMO management system.

7. CAMO TECHNOLOGY ARCHITECTURE GUIDELINES

The objective of this chapter is then to purpose and elaborate how the technology identified and discussed on paragraph 3.3 may be applied in a CAMO environment. Technology is always in continuous evolution and there are new solutions emerging every day that can present themselves as better options in optimizing and efficient processes. As discussed before industry 4.0 applied to aviation is bringing great breakthroughs to this business. The use of CPS, IoT, Big Data Analytics, Artificial Intelligence, Cloud computing and others are being used more often in production or maintenance environments. However, bringing some of these technologies to a CAMO can also bring an easier data treatment, the creation of more valuable information which leads to a better decision making. This will lead to an effective safety management.

It's understandable that there are technologies that can be transversal to all the processes. How it was possible to verify, CAMO activities are generally all about managing information to guarantee the AMP efficiency application and at same time follow the organization objectives as any other business but having a special focus on safety. So being the use of cloud computing can be a breakthrough to a CAMO. It can able a CAMO organization to easily share the necessary information to all the internal and external stakeholders but also to the aircrafts itself storing all the data and records required in real time. This is a technology that can be present in all the CAMO processes.

There are technologies that were previously discussed, that also can improve each of the identified processes. The following table discuss the possible usages of such key technology through the level 2 processes providing a guideline how they can be used to have process improvement breakthroughs.

Table 43 - Technologies process enablers guidance

Process	Technological Analysis	Key technologies considered
1.1-Documental Management	The Documental Management process is where system documents are analyzed, verified with the objective of being approved. During the process it may be necessary an external documental approval by the Competent Authority. So being the use of collaborative tools and cloud computing may provide an efficiency increases to this process in terms of documental sharing during the document design and development, the documentation approval, and the final document repository where all the staff may be alerted and may access the documental orientations given. It can also be an instrument where all the parts can propose system improvements.	▪ Cloud Computing • Collaborative tools

Process	Technological Analysis	Key technologies considered
1.2-Risk Management	Risk Management is a cycle process that shall integrate the data generated all through the CAMO processes to evaluate safety and organization risks and provide possible actions to avoid or mitigate that risk. This risk can come from the internal environment or external environment. In this case the use of big data analytics may bring advantages in terms of evaluate and predict how the organization is evolving in terms of risk considering internal or external factors. With this data, the use of intelligent algorithms could help CAMO to provide the necessary orientation to define what actions can be done to mitigate the risk in an effectiveness way. The Risk Management can be then developed in a Business Intelligence environment. Once again cloud computing can also be a technology that can provide the best way to share this information through the organization and provide any easy interaction to control how the risk and the mitigation action are being developed.	▪ Cloud Computing ▪ Artificial Intelligence ▪ Data Analytics • Data Mining
1.3-System Monitoring	System Monitoring process provides management reports, KPI analyses and goals and actions definitions. So being, the technology that may provide a high-level breakthrough within this process scope is the technology that can use the data available to produce a detailed high level information report to able better decisions to the responsible managers. For this purpose, big data analytical with Data Mining capacity for the environmental organizational analyses, the use of artificial intelligence within a business intelligence system can give to organization managers a clear picture of the organizational status at different levels but also provide the predictions of its evolutions. This will certainly lead to better decision making to guarantee that all the goals are achieved. Once again cloud computing with the collaborative tools, can also provide the necessary data storage to reports sharing and verification, to approval cooperation and able to distribute in interactive way the goals and actions defined during the process to all CAMO areas.	▪ Cloud Computing • Collaborative tools ▪ Artificial Intelligence ▪ Data Analytics • Data Mining

Process	Technological Analysis	Key technologies considered
2.1-Audit Management	During the Audit Management Process there are 2 phases that may be considered. The audit plan and the audit realization phase. During the audit plan, it must be considered all the information about the system to evaluate the organizational sensitive areas and the requirements to be audited. The output of this phase is a plan that must be accomplished and controlled. The other moment is the audit realization, where an audit team must be nominated to perform the required audit. Each of these phases shall have an easy access to information and shall have an easy method to elaborate the audit plan and the audit reports. This could be provided by the cloud computing technology, where each of the phase responsible can access to the necessary specific information, but also can elaborate the plans or reports required in a collaborative approach. In other hand the audit realization require access to audit checklist during the audit and an easy way to report each issue that can be an audit finding. For that purpose, IoT and cloud computing could lead the auditors to an easy approach, enabling them to have real time access to documentation and to requirements and to develop instant finding report enabling, for example, the collection of real time evidence to support the final report to be issued (e.g., the elaboration of a video or taking a picture through a smartphone). This can provide a better solution to evidence traceability and help to have a quicker and easy way to issue the final audit report.	▪ Cloud Computing • Collaborative tools ▪ IoT
2.2-Findings Management	Finding Management is the process where the findings are analyzed and treated to improve the system compliance and avoid recurrence. During this process it may be necessary to send a Corrective Action report to the authority. The findings sources can be the audit process, an external audit or a reported issue made by a stakeholder. This process requires different areas approach and accessing to several information which leads to the use of the cloud computing where all the information can be stored, but also to the use of IoT that can enable real time insertion of evidence that may prove the actions taken (for example a video or a picture through a smartphone).	▪ Cloud Computing ▪ IoT
2.3-Internal Reporting	The Internal Reporting is a process where all the internal stakeholders can participate whenever they identify any issue that can lead to safety issue improvement. The easiest way to motivate collaborators cooperation is to make it easier to them and to show that their reports have continuity in terms of analysis and treatment as necessary. The use of IoT may provide the breakthrough needed enabling each CAMO person to report using for example their smartphone as a reporting tool, but also to receive the necessary feedback. The cloud sharing also will facilitate the information access from the reports analyses responsible.	▪ Cloud Computing ▪ IoT

Process	Technological Analysis	Key technologies considered
2.4-Internal Investigation	The Internal Investigation requires access to all the CAMO information to facilitate the internal investigators to have a transparent investigation. Normally the investigation team consists of people from various areas that need to share data and documents. Once that in the end of this process is necessary to develop an investigation report, technologies can help through the cloud computing where collaboration tools can be used. IoT that can also be a process enabler during the investigation for evidence collection or to documentation access and requirement verification.	▪ Cloud Computing • Collaborative tools ▪ IoT
2.5-Occurrence Reporting	Occurrence Reporting is a process that requires the development of a report to be issued to the Competent Authority to inform about the Occurrence. The source of the occurrence can be an and internal or external entity, so being a system can be held to provide occurrence report interface with internal or external stakeholders where they can directly report any issue occurred. For this process cloud computing could be an asset to connect the different actors of this process.	▪ Cloud Computing
3.1-Operation Control	The Operation Control process receives the flight information report and depending on the maintenance required and operation schedule the aircraft may be induced to maintenance or be considered to fly. To promote the necessary decisions the personnel responsible for this process must have a continuous interaction with the necessary data about the aircraft condition. If the aircraft has CPS, with the use of IoT, the data systems can automatically receive the information about the aircraft flight and any report made by the operational area. If the aircraft has no CPS system, operational area may provide the flight report using IoT technologies. In both cases flight may feed the data required using the cloud technologies that each process responsible can access in real time. Assessing to the aircraft data in the cloud and using artificial intelligence algorithms processes that develop intelligent evaluators may help decision makers to decide possible deferments, anticipate eventual maintenance inspections or accept any tolerance within the data requirements. Artificial intelligence also can be used to establish the release of the aircraft if all airworthy conditions are met. This leads to the full digitalization of the aircraft logbook as discussed before but also to a high level of decision support.	▪ Cloud Computing ▪ CPS ▪ IoT ▪ Artificial Intelligence

Process	Technological Analysis	Key technologies considered
3.2-Pre-Flight Inspection	During the Pre-Flight Inspections the personnel shall be access to the aircraft log records, to the airworthiness and records as required. During the Pre-Flight inspection the use of virtual augmentation where technical data integrated with aircraft visualization can help personnel to perform a most effective inspection being a breakthrough to this process. Using this technology, the personnel can access directly in an interactive way to the data that defines the inspections to be performed, be informed about the tools that shall be used and where they are stored. If any deficiency is found, personnel shall directly report that issue and request the necessary maintenance. Technology like the use of a smartphone or other device can provide the deficiency data and evidence collected that shall be reported.	▪ Cloud Computing ▪ Virtual Augmentation ▪ IoT
3.3-Maintenance Control	During the Maintenance Control process, personnel shall have access to the maintenance data and to the aircraft records status. During the process it may be necessary to exchange data with MRO, DOA or with Type Certificate Post Holder. The information data may be shared with the stakeholders using cloud computing to guarantee the most update and precise data available. As considered in the Operational Control process, intelligent algorithms can be used to help process decision makers in the deferment analyses or also in the engineering support analyses. If MRO has Virtual augmentation capabilities or CPS tools informational links can be developed to feed the engineering evaluations as necessary. For specific items MRO may be able to produce items using 3-D technology. This is a technology that can grow in the future but probably will be necessary to surpass some certification issues. With the use of this technology, CAMO may provide improve supervision tasks and provide better engineering support as required.	▪ Cloud Computing ▪ Artificial Intelligence ▪ Additive Manufacturing (MRO) ▪ CPS (MRO) ▪ IoT (MRO) ▪ Virtual Augmentation (MRO)
3.4-Maintenance Planning	Maintenance Planning goal is to define the maintenance plan schedule required for a determined cycle. For that is necessary operational information, management data, airworthiness records data and provider available data. The integration of this data facilitated by use of the Artificial Intelligence algorithms can provide to CAMO an optimized maintenance plan which leads to the aircraft minimum stoppages possible.	▪ Cloud Computing ▪ Artificial Intelligence
3.5-Permit to Fly Issuance	To issue the Permit to Fly, personnel must have access to the aircraft technical data and records, so that they can have the updated aircraft status. If a physical check must be performed, Permit to Fly staff may use virtual augmentation and IoT to have directly access to the applied data and requirements. IoT can also provide the Permit to Fly issue as required.	▪ Cloud Computing ▪ Virtual Augmentation ▪ IoT

Process	Technological Analysis	Key technologies considered
4.1-Data Management	The Data Management process is an essential process where the data issued from have different sources that must be evaluated to check its compliance with CAMO scope. In this process the cloud computing could help to share the applicable data as necessary with the stakeholders.	▪ Cloud Computing
4.2-Reliability Management	Reliability Management is a cycle process that requires data from different sources and the calculation of reliability indicators. To proceed to this process, beyond the use of the cloud computing, the use of artificial intelligence, data analytics and Data Mining can provide specific algorithms that can predict components and items failures or can provide more effective life limits that can lead to AMP improvements.	▪ Cloud Computing ▪ Artificial Intelligence ▪ Data Analytics • Data Mining
4.3-AMP Management	The AMP Management goal is to maintain aircraft AMP updated in accordance with the applicable data. The AMP is the central document that defines which maintenance is required by each CAMO aircraft. The use of cloud computing could guarantee a management advantaged in the document sharing with all stakeholders.	▪ Cloud Computing
4.4-Directive Management	Directive Management requires an evaluation of the directives issued by the authorized authorities. The cloud computing could help to share what and where directives shall be applied.	▪ Cloud Computing
4.5-Configuration Management	Configuration Management information could be maintained in the cloud where all the stakeholders can access and verify all the digital information established about aircraft configuration, components or systems that can be installed in the aircraft, configuration limitations and equipment list like MMEL, MEL or Mission MEL.	▪ Cloud Computing
4.6-Aircraft AW transfer	Aircraft Airworthiness transfer require documental analyses and a request to the Competent Authority. So being, using cloud computing to documental sharing and storage can bring this process an advantage.	▪ Cloud Computing
5.1-AW Review Evaluation	Once again, this process requires aircraft documental analyses or the request for the Airworthiness Review development. So being, to easily having data access, cloud computing can eventually give same advantage to this process.	▪ Cloud Computing
5.2-AW Review Issuance	During the Airworthiness Review issuance, it's necessary Airworthiness Review staff to proceed to documental analyses, physical survey and elaborate a compliance report. Within this process Virtual Augmentation can be helpful during the physical survey and cloud computing can also provide flexible documental access and facilitate the required reports elaboration.	▪ Cloud Computing • Collaborative tools ▪ Virtual Augmentation ▪ IoT

Process	Technological Analysis	Key technologies considered
6.1-HR Planning	Human Resources Planning requires a Human Resources data analyses for which any easy data access can bring same value. Once within this process is included the personal evaluation, data analytics can bring some benefits to verify trends or alerts in terms of training or personnel needs. This will enable to take some action relative to the personnel before any issue occurs.	▪ Cloud Computing ▪ Data Analytics • Data Mining
6.2-HR Recruitment	Human Resources Recruiting is a process where is essential to access job requirements to evaluate the curriculum and subsequent documents of the candidate. During this process it's possible having the need to request the authority approval for that job position. Cloud computing can facilitate this data sharing.	▪ Cloud Computing
6.3-HR Qualification Control	This process can be fully automatized, alerting each time a any qualification is expiring and training is required. To have full access to all staff qualifications records cloud computing may provide a flexible way to access to data.	▪ Cloud Computing
7.1-Facility Planning Control	This process is also a report analysis and a plan development process. So being the principal technology that can bring any advantage in terms of data access could be the cloud computing.	▪ Cloud Computing
7.2-Facility Report	Facility Report can use collaborative approach to easily report any facility problem identified. So being the use of IoT to this process can bring advantages making reporting easier and flexible with use for instance of a smartphone or other similar device.	▪ Cloud Computing ▪ IoT
8.1-Contracting/ Subcontracting	In addition of being a documental and data analysis process, Contracting/Subcontracting requires provider evaluation to proceed to the service hiring or product acquisition. So being, data analytics can bring some advantage in terms of historical analyses but also service evaluation service terms.	▪ Cloud Computing ▪ Data Analytics • Data Mining
8.2-Service / Product Provider Control	Like Contracting/Subcontracting process, service Provider Control requires provider evaluation. With the use of data analytical but also artificial intelligence algorithms can eventually bring a high level of automatization where some alerts of how the service is evaluating in time and define specific decision that can bring value to the organization.	▪ Cloud Computing ▪ Artificial Intelligence ▪ Data Analytics • Data Mining

The technology identified for each process are only orientations that can bring more value during the processes. The following figure is a scheme that provide a possible technological view of the system where all the technological solutions proposed may be integrated.

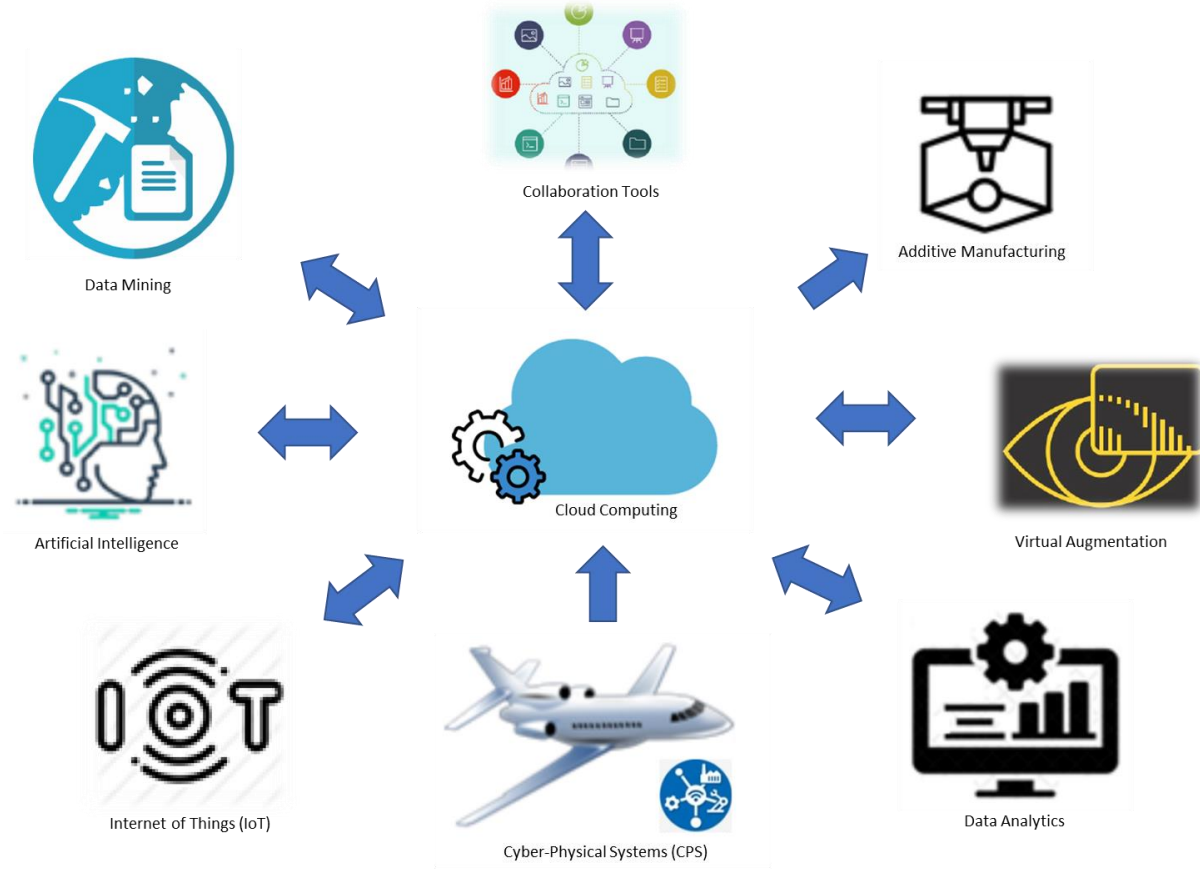


Figure 28 - Technological guidance view

In figure 28 it's possible to observe that central image is referred to the cloud computing being that all the other technologies are surround it. The objective is to purpose that data shall be held in a unique repository and shared and available to all the organizational levels as required. Cloud computing technology enables a potential sharing of data and collaboration that can be a breakthrough in this specific type of organization where access to the information makes the difference. The CPS systems and IoT enable the automatization of data input, reducing errors and increasing data quality, more complete and with more information. At same time IoT able users to access real time update data whenever is necessary in an easier way. Virtual augmentation able users to access to interactive data but also to report possible deficiencies more easily and with more information to the decision maker. Artificial Intelligence, Data Mining and data analytics can support management decisions, provide alerts and predictions from the CAMO generated data. Additive manufacturing can also be used during maintenance providing CAMO full control and awareness of specific components being installed on the aircrafts.

In addition to this figure, the appendix figure 69 provides an overview of the technological architecture guidance where it's possible to verify in a schematic view of the level 2 architecture processes integrated with table 43 and figure 28 technological enablers proposal. Once again, it's possible to verify that cloud computing has a central position. In the middle figure is also possible to see the aircraft since that with CPS capabilities an aircraft can directly report the information of the aircraft status to the CAMO system. If the aircraft has not a CPS technology, IoT can be used but with

human data reporting sources. In this scheme is also possible to verify within each process which technology can be used to increase process efficiency in the way discussed and analyzed in table 43.

This architecture scheme is just an orientation once technology is always change and in constant evolution. This approach can provide the way to develop a more oriented and successful system. With this architecture guidance where established the possible technological enablers that can level the CAMO process and information architecture.

8. CONCLUSIONS

8.1. SYNTHESIS OF THE DEVELOPMENT WORK

Safety is the main driver that has been guiding all the aviation policies worldwide. The objective of achieving "zero fatalities in commercial operations in 2030 and beyond" (ICAO 2019) requires to go through a complex path where all the aviation stakeholders share their part of responsibility. This responsibility starts with world entities like ICAO but flows down to regional entities as EASA, until companies and organizations that manage, maintain, design or produce aviation products or services. At companies level, Continuous Airworthiness Management Organizations have an essential role once they have to ensure that they have the necessary processes to guarantee that, at any time during aircraft operation life, the airworthiness requirements are complied, and the aircraft is safe for operation (EASA 2021b).

The main goal of this dissertation was to propose a CAMO process and information architecture proposal that can lead to an architecture framework that may promote a high-level standardization roadmap to an information system development. The concept was to develop the architectures that may leverage CAMO efficiency in terms of safety but also in terms of current business operation bringing value to all CAMO stakeholders. To develop these architectures, it was necessary to proceed to a multi subject study that enabled the architectures final proposal. During this study several Enterprise Architecture were evaluated. Known Frameworks like Zachman, TOGAF, NAF were analyzed being finally considered the architecture proposed by Pedro et al. which lead to the definition of the five main components of an Enterprise Architecture: Organizational Architecture, Business Architecture, Information Architecture, Application Architecture and Technological Architecture. Consequently, it was within this scope that the proposed framework architectures were built. In this work is then proposed the Business Process Architecture that identifies how business process interacts, the Information Architecture that identifies the high-level requirements of information for the CAMO, but also discuss how the actual technology used in aviation industry may leverage each of the identified processes.

After the architecture study, it was necessary to evaluate and understand how CAMO requirements are defined, organized and how they integrate Safety Management System as required. For that study it was then analyzed ICAO regulations with particular focus on ICAO Annex 8 - "Airworthiness of Aircraft", where main principles to guarantee the aircraft airworthiness are established, and ICAO Annex 9 - "Safety Management" that defines the SMS principles how each organization shall be structured. After this evaluation it was relevant to understand how the regional requirement's structure are built. This led to the evaluation and study of the regulation (EU) No 1321/2014 where the requirements for the "continuing airworthiness of aircraft and aeronautical products, parts and appliances and on the approval of Organizations and personnel involved in these tasks" are defined. This document is composed by several parts. The study was developed with focus on more relevant parts, namely Part-CAMO and Part-M requirements which are within this work scope. This enabled to understand the established requirements definition and framework but also the principal tasks that a CAMO must perform at management and operational level. At management level CAMO must guarantee the development of the activities like findings treatment, occurrence reporting, risk management or the compliance management. At operational level activities like Pre-flight

inspections, maintenance program management, maintenance control management, directives management must also be guaranteed to maintain the aircraft airworthy.

After the regulation study, technological industry aviation evaluation was made. From several authors it was identified and discussed how the use of IOT, cloud computing, big data analytics, the use of Cyber-Physical Systems, Artificial intelligence, Virtual Augmentation and Additive Manufacturing are bringing several breakthroughs to this industry. Although the daily technology evolution, these enablers were considered during the technological process evolution guidelines discussion. Following the possible architectures theorical approach and the regulation analyses, this work proceeded to the architecture frameworks components proposal. To achieve this goal, the first architecture to be developed and proposed was the business process architecture design that shall integrate all the required CAMO tasks. After regulation evaluation it was possible to identify 31 level 2 processes that can be reorganized in 8 level 1 processes. To perform this evaluation, it was used table 44 where each requirement was analyzed and distributed accordingly with the specified scope. The identified processes where the following:

- 1-Strategic Management
  - 1.1-Documental Management
  - 1.2-Risk Management
  - 1.3-System Monitoring
- 2-Compliance Management
  - 2.1-Audit Management
  - 2.2-Findings Management
  - 2.3-Internal Reporting
  - 2.4-Internal Investigation
  - 2.5-Occurrence Reporting
- 3-Aircraft Management
  - 3.1-Operation Control
  - 3.2-Pre-Flight Inspection
  - 3.3-Maintenance Control
  - 3.4-Maintenance Planning
  - 3.5-Permit to Fly Issuance
- 4-Airworthiness Data Management
  - 4.1-Data Management
  - 4.2-Reliability Management
  - 4.3-AMP Management
  - 4.4-Directive Management
  - 4.5-Configuration Management
  - 4.6-Aircraft AW transfer
- 5-Airworthiness Review Management
  - 5.1-AW Review Evaluation
  - 5.2-AW Review Issuance
- 6-HR Management
  - 6.1-HR Planning
  - 6.2-HR Recruitment
  - 6.3-HR Qualification Control
- 7-Facility Management
  - 7.1-Facility Planning Control
  - 7.2-Facility Report
- 8 - Procurement Management
  - 8.1-Contracting/Subcontracting
  - 8.2-Service/Product provider control

Figure 29 - Processes hierarchy

For each level 2 process was then established a specific process framework that can be verified from table 13 to table 40. In this framework it was identified the inputs, the outputs, the information required and that shall be generated during the process. This framework helped to develop the level 3 design using BPMN. In level 3 design it's possible to verify high level of detail of the tasks determined by the requirements. In fact, it's possible to trace in each BPMN process designed activity, the applied requirements when applicable. To design the BPMN processes it was also needed to define the informational needs for each process. After the identification of each process, the development of the level 3 BPMN design and the definition of the interaction between them it was possible to develop the level 2 architecture and then the top level 1 architecture. The level 3 processes can be verified from figure 31 to figure 58, while the level 2 architecture can be seen from figure 18 to figure 25. Top level 1 architecture is established in figure 26. These architectures show how processes shall interact with each other through the different levels.

With the business process architecture designed, it was necessary to clarify with high detail the informational entities already identified during the BPMN design. So being, were identified 83 informational objects that are defined on table 41. From these objects the following 11 objects where identified as informational entities that require an informational storage system:

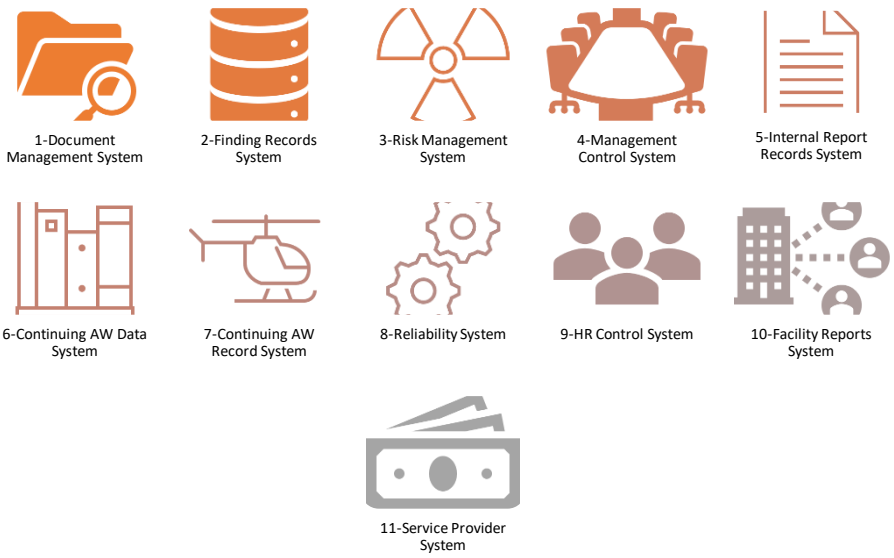


Figure 30 - Data entities

After this entities identification, DFD were developed in other to create the informational architecture view. Following the required alignment with the Business Process Architecture, it was defined three DFD levels between level 0 and level 2. Level 0 DFD shows the external informational interactions between CAMO and the stakeholders and it can be seen in figure 27. After this design it was possible to develop level 1 DFD, shown on

figure 60. Level 1 DFD shows how level 1 processes exchange information between them, stakeholders and data storage systems identified before. Level 2 DFD are displayed from

figure 61 to

figure 68 and each figure identifies how level 2 processes also trade information between them, the stakeholders and the identified data storage systems. DFD enabled to show the information flow perspective with a higher level of detail and helped to establish and define which type of information should be maintained for each storage system through table 42 descriptions.

The final approach of this work was to discuss how the identified and present technology could leverage each of the identified process. n table 43 it is presented for each process, how each technology could provide specified process improvements. Each of the identified technologies may have positive impacts. It was discussed how the cloud computing can have a transversal impact, namely to the information share and flexibility providing always up to date and available data. IoT can provide a breakthrough in reporting processes and in communication with aircraft systems, namely trough CPS. On Management Processes, Human Resources Processes and Procurement Processes Artificial Intelligence, Data Analytics and Data Mining can provide a better support decision approach. The use of Virtual Augmentation or Additive Manufacturing together with IoT, can also provide faster and better information to engineering support during Maintenance Control, Permit to Fly Process, Airworthiness Review Processes or Pre-Flight Inspection process. This discussion is resumed in the scheme presented on figure 69.

Hence, the integration of these architectures provides to any CAMO the required components to establish the framework that can lead to development of the required information system fully aligned with CAMO regulation requirements. This approach will enable any developer to understand the dimension and guidelines needed to comply with these requirements, having safety, optimization, technology and effectiveness as a driver. In other hand, if a CAMO follows as defined in this document, the organization's system will be closer to fully comply with required requirements. Providing this standardization requirements approach will certainly ensure a high level of confidence on CAMO, which will decrease the aviation operation risk that certainly will lead to a high level of safety as required by the international responsible entities.

8.2. LIMITATIONS

According with Pedro et al. an Enterprise architecture shall be composed by the organizational architecture, business processes architecture, information architecture, technological architecture and by the Application architecture. Within this work scope it was only proposed the business processes and information architectures. Was also discussed how technological enablers may improve these processes. Organizational and application architecture has not been evaluated once these architectures have a high dependence of the specific CAMO reality, depending on their vision, organizational structure and business framework. The purpose of this work was a definition of a high-level business process and informational CAMO architectures.

The Continuing Airworthiness Regulation doesn't include the full business view that any organization shall have to be sustainable. This includes the need of having a budget activity or process within the system, having a client management approach or a marketing process for example. This work only focused on the CAMO regulation requirement approach.

The scope of the architecture developed and proposed doesn't include the processes or the possible integration with other existing organizations within the aviation industry. Namely it wasn't evaluated the integration of this processes with Part-145, Part-CAO or Part-ML defined in the EASA Regulatory Framework, although there are organizations that may accomplish with these requirements.

To have a limited scope within the technology evaluation, this work considered the technology used within the industry 4.0 scope. However, it may be considered other technology that can provide breakthroughs to the CAMO processes which can be evaluated and may optimize the identified processes. Furthermore, technology is always evolving, which means that the guidelines provided today can become outdated in a near future, and new technological breakthroughs may appear.

8.3. FUTURE WORK

After this high-level CAMO architectures proposal, it would be valuable to evaluate how this architecture proposal can be implemented in an existing organization. This will lead to a more detailed and tailored work that can provide improvements to the high-level process and information architectures. It will also enable to propose an organizational and application architecture according with that specific CAMO reality which may provide a path of how all the architecture can be integrated within a general framework. In fact, the development of any information system aligned with this architecture scope will require a lower-level definition that will lead to a tailored approach depending on the organizational situation. This means that any development shall consider the organizational CAMO reality, in terms of human resources number, in terms of organizational structure and scope complexity. Complex organizations with high level of technology available will require different approach comparing with a less complex organization without so many technologies available.

Other future work to be developed is to evaluate which and how business processes could be included in CAMO organization and how they can interact with the identified processes, maintaining the required safety approach. Budget, client or marketing processes and other processes may provide a real improvement to this architecture.

Within the business view scope evaluation, a possible improvement of this work is to evaluate how ISO 9001 - "Quality Management Systems requirements" could be integrated within this scope. ISO 9001 is a management system standard that uses the Deming Cycle approach (PDCA Cycle - Plan, Do, Check, Act) approach, defining a series of requirement so that any organization can be focused on product or service delivery but at same time having a self-continuous improvement philosophy. The implementation of CAMO architecture integrating a management system approach may provide a double certification to any organization although for different scopes.

This work can be also the first step to future development of a full continuous airworthiness architecture where other processes can be integrated, as necessary, in compliance with Continuing Airworthiness Regulation (EU) No 1321/2014. It can be evaluated how Part-145, Part-CAO, Part-ML, Part-147 processes and others can be fully integrated, synergistically in a way that can bring value to any aviation organization in accordance with their activity scope.

The development of new technology can also provide an interesting work to be developed in terms of evaluating how processes can be changed due to that technology. How was possible to verify throughout this document, ICAO, EASA and IATA anticipate several changes due to technology evolution which can lead to a future work more oriented to technology.

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APPENDIX

Table 44 - Part CAMO and Part M requirements classification

Requirement #.#		Related Requirement	Requirement Classification		Level 1 Process	Level 2 Process
CAMO.A.005 Scope	-	N/A	General Requirement		N/A	N/A
CAMO.A.105 Competent Authority	(a)	N/A	General Requirement		N/A	N/A
	(b)	N/A	General Requirement		N/A	N/A
	(c)	N/A	General Requirement		N/A	N/A
CAMO.A.115 Application for an Organization certificate	(a)	Annex I Part M	Manag.	Process /Task	- Strategic Manag.	- Documental Manag.
	(b)(1)	Annex I Part M	Manag.	Process/Task	- Strategic Manag.	- Documental Manag.
	(b)(2)	CAMO.A.130	Manag.	Process /Task	Strategic Manag.	- Documental Manag.
CAMO.A.120 Means of compliance	(a)	N/A	General Requirement		N/A	N/A
	(b)	N/A	Manag.	Doc./Record Process /Task	- Strategic Manag.	- Documental Manag.
CAMO.A.125 Terms of approval and privileges	(a)	N/A	General Requirement		N/A	N/A
	(b)	N/A	General Requirement		N/A	N/A
	(c)	CAMO.A.300	General Requirement		N/A	N/A
	(d)(1)	N/A	General Requirement		N/A	N/A
	(d)(2)	N/A	General Requirement		N/A	N/A
	(d)(3)	N/A	Support	Process/task	- Procurement	- Contracting/ Subcontracting
	(d)(4)	M.A.901(f) M.A.901	Core	Process/task	- AW Review Manag.	- AW Review Evaluation - AW Review Issuance
	(d)(5)	CAMO.A.125 (b)(2)	Core	Process/task	- AW Data Manag.	AMP Manag.
	(e)(1)	M.A.901	Core	Process/task Doc./Record	- AW Review Manag.	- AW Review Evaluation - AW Review Issuance
	(e)(2)	M.A.901 M.A.904 (b)	Core	Process/task Doc./Record	AW Review Manag.	- AW Review Evaluation - AW Review Issuance
	(f)	CAMO.A.300 Part.21.A.711	Core	Process/task Doc./Record	- Aircraft Manag.	Permit to Fly Issue
CAMO.A.130 Changes to the Organization	(a) (1)	CAMO.A.200 (a)(3)	Manag.	Process/Task Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(2)	CAMO.A.305	Support/ Manag.	Process/Task Doc./Record	- Strategic Manag. - HR Manag.	- Documental Manag. - HR Recruitment
	(a)(3)	CAMO.A.305	Manag.	Process/Task Doc./Record	- Strategic Manag.	- Documental Manag.

Requirement #.#		Related Requirement	Requirement Classification		Level 1 Process	Level 2 Process
	(a)(4)	N/A	Manag.	Process / Task	- Strategic Manag.	- Documental Manag.
	(b)	CAMO.A.120(b) CAMO.A.310(C) CAMO.A.305(g) M.A.302(C)	Manag.	Process/Task Doc./Record	- Strategic Manag.	- Documental Manag.
	(c)	CAMO.A.115	Manag.	Process/Task Doc./ Record	- Strategic Manag.	- Documental Manag.
CAMO.A.135 Continued validity	(a)(1)	N/A	General Requirement		N/A	N/A
	(a)(2)	CAMO.A.140	General Requirement		N/A	N/A
	(a)(3)	N/A	General Requirement		N/A	N/A
	(b)	N/A	General Requirement		N/A	N/A
	(c)	N/A	General Requirement		N/A	N/A
CAMO.A.140 Access	(a)	CAMO.A.105	General Requirement		N/A	N/A
	(b)	N/A	General Requirement		N/A	N/A
CAMO.A.150 Findings	(a)(1)	N/A	Manag.	Process/Task	- Compliance Manag.	- Findings Manag.
	(a)(2)	N/A	Manag.	Doc./Record Process/Task	- Compliance Manag.	- Findings Manag.
	(a)(3)	N/A	Manag.	Process/Task	- Compliance Manag.	- Findings Manag.
	(b)	N/A	Manag.	Process/Task	- Compliance Manag.	- Findings Manag.
CAMO.A.155 Immediate reaction to a safety problem	(a)	CAMO.B.105	Manag.	Process/Task	- Compliance Manag.	- Findings Manag.
	(b)	N/A	Manag.	Process/Task	- Compliance Manag.	- Findings Manag.
CAMO.A.160 Occurrence Reporting	(a)	Regulation (EU) No 376/2014 Regulation (EU) 2015/10181	Manag.	Process/Task	- Compliance Manag.	- Occurrence Reporting
	(b)	N/A	Manag.	Process/Task	- Compliance Manag.	- Occurrence Reporting
	(c)	Regulation (EU) No 376/2014 Regulation (EU) 2015/10181	Manag.	Process/Task Doc./Record	- Compliance Manag.	- Occurrence Reporting
	(d)	N/A	Manag.	Process/Task	- Compliance Manag.	- Occurrence Reporting
	(e)	N/A	Manag.	Process/Task	- Compliance Manag.	- Occurrence Reporting
CAMO.A.200 Management System	(a)(1)	CAMO.A.200 CAMO.A.202 CAMO.A.205	Manag.	Process/Task	- Strategic Manag.	- System Monitoring
	(a)(2)	N/A	Manag.	Doc./ Record	- Strategic Manag.	- Documental Manag. - System Monitoring
	(a)(3)	CAMO.A.160 CAMO.A.202	Manag.	Process/Task	- Strategic Manag. - Compliance Manag.	- Risk Manag. - Audit Manag. - Internal Investigation

Requirement #.#		Related Requirement	Requirement Classification		Level 1 Process	Level 2 Process
	(a)(4)	N/A	Support	Process/Task	- HR Manag.	- HR Planning - HR Recruitment - HR Qualification Control
	(a)(5)	N/A	Manag.	Process/Task Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(6)	N/A	Manag.	Process/Task	- Strategic Manag. - Compliance Manag.	- Documental Manag. - Audit Manag. - Finding Manag.
	(a)(7)	N/A	Manag.	Process/Task Doc./Record	- Strategic Manag.	- Documental Manag.
	(b)	N/A	Manag.	Process/Task	- Strategic Manag.	- System Monitoring
	(c)	N/A	General Requirement		N/A	N/A
	d)	N/A	General Requirement		N/A	N/A
CAMO.A.202 Internal safety reporting scheme	(a)	CAMO.A.160	Manag.	Process/Task	- Compliance Manag.	- Internal Reporting
	(b)	CAMOA.A.200	Manag.	Process/Task	- Compliance Manag.	- Internal Reporting
	(c)(1)	CAMO.A.200(a)(3)	Manag.	Process/Task	- Compliance Manag.	- Finding Manag. - Internal Reporting - Internal Investigation
	(c)(2)	N/A	Manag.	Process/Task	Compliance Manag.	- Finding Manag. - Internal Reporting
	(d)	N/A	General Requirement		N/A	N/A
	(e)	N/A	General Requirement		N/A	N/A
CAMO.A.205 Contracting and subcontracting	(a)(1)	CAMO.A.200(a)(3)	Support	Process/Task	- Procurement	N/A
	(a)(2)	CAMO.A.200(a)(3)	Support	Process/Task	- Procurement	N/A
	(b)	N/A	Support	Process/Task	- Procurement	- Contacting/ Subcontracting - Service/Product Provider Control
CAMO.A.215 Facilities	-	CAMO.A.305	Support	Process/Task	- Facility Manag.	- Facility Planning Control - Facility Report
CAMO.A.220 Record-keeping	(a)(1)	M.A.305 M.A.306	Core	Doc./Record	- Aircraft Manag. - AW Data Manag.	- Operation Control Pre-Flight - Inspection Maintenance Control - Maintenance Planning

Requirement #.#		Related Requirement	Requirement Classification		Level 1 Process	Level 2 Process
						- Data Manag. - AMP Manag. - Configuration Manag. - Aircraft AW transfer
	(a)(2)	N/A	Core	Doc./Record	- Aircraft Manag.	- Maintenance Control
	(a)(3)	CAMO.A.125 (e)	Core	Doc./Record	- AW Review Manag.	- AW Review data update
	(a)(4)	CAMO.A.125 (f)	Core	Doc./Record	- Aircraft Manag.	- Permit to Fly Issue
	(a)(5)	CAMO.A.220 (a)(2) CAMO.A.220 (a)(3) CAMO.A.220 (a)(4)	General Requirement		N/A	N/A
	(a)(6)	N/A	General Requirement		N/A	N/A
	(b)(1)(i)	CAMO.A.200	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(b)(1)(ii)	CAMO.A.205	Support	Doc./Record	- Procurement	- Contacting/ Subcontracting - Service/Product Provider Control
	(b)(2)	CAMO.A.205	General Requirement		N/A	N/A
	(c)(1)(i)	N/A	Support	Doc./Record	- HR Manag.	- HR Recruitment - HR Qualification Control
	(c)(1)(ii)	N/A	Support	Doc./Record	- HR Manag.	- HR Recruitment - HR Qualification Control
	(c)(2)	N/A	Support/ core	Doc./Record	- AW Review Manag. - HR Manag.	- AW Review data update - HR Recruitment - HR Qualification Control
	(c)(3)	N/A	Support	Doc./Record	HR Manag.	- HR Recruitment - HR Qualification Control
	(d)	N/A	General Requirement		N/A	N/A
	(e)	N/A	General Requirement		N/A	N/A
	(f)	N/A	General Requirement		N/A	N/A
CAMO.A.300 Continuing airworthiness management	(a)(1)	N/A	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(2)	CAMO.A.200(a)(2)	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.

Requirement #.#		Related Requirement	Requirement Classification		Level 1 Process	Level 2 Process
exposition (CAME)	(a)(3)	N/A	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(4)	CAMO.A.305(d)	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(5)	CAMO.A.305(a)(3) CAMO.A.305(a)(5) CAMO.A.305(b)(2) CAMO.A.305(f)	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(6)	CAMO.A.305(a)(3) CAMO.A.305(a)(5) CAMO.A.305(b)(2) CAMO.A.305(e) CAMO.A.305(f)	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(7)	CAMO.A.305(a)(3) CAMO.A.305(a)(5) CAMO.A.305(b)(2) CAMO.A.305(e) CAMO.A.305(f)	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(8)	CAMO.A.125(c) CAMO.A.305(e)	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(9)	N/A	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(10)	CAMO.A.202	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(11) (i)	CAMO.A.200	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(11) (ii)	CAMO.A.205(c)	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(11) (ii)	N/A	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(11) (iv)	CAMO.A.115(b) CAMO.A.130(c)	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(11) (v)	N/A	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(12)	M.A.201	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(13)	CAMO.A.315(c)	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(a)(14)	N/A	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
	(b)	N/A	Manag.	Process/Task	- Strategic Manag.	- Documental Manag.
	(c)	CAMO.A.130(a) CAMO.A.300(a) (11)(iv) CAMO.A.300(a) (11)(v)	Manag.	Doc./Record	- Strategic Manag.	- Documental Manag.
CAMO.A.305 Personnel requirements	(a)(1)	N/A	General Requirement		N/A	N/A
	(a)(2)	CAMO.A.200	General Requirement		N/A	N/A
	(a)(3)	N/A	General Requirement		N/A	N/A
	(a)(4)	N/A	General Requirement		N/A	N/A
	(a)(5)	N/A	General Requirement		N/A	N/A
	(a)(6)	CAMO.A.305 (a)(3) CAMO.A.305 (a)(4) CAMO.A.305 (a)(5)	Support	Process/Task	- HR Manag.	- HR Planning - HR Recruitment

Requirement #.#		Related Requirement	Requirement Classification		Level 1 Process	Level 2 Process
	(a)(7)	CAMO.A.305 (a)(3) CAMO.A.305 (a)(4) CAMO.A.305 (a)(5)	Support	Process/Task	- HR Manag.	- HR Planning - HR Recruitment
	(b)(1)	N/A	General Requirement		N/A	N/A
	(b)(2)	N/A	General Requirement		N/A	N/A
	(c)	CAMO.A.305 (a)(3) CAMO.A.305 (a)(4) CAMO.A.305 (a)(5)	Support	Process/Task	- HR Manag.	- HR Planning - HR Recruitment
	(d)	N/A	Support	Process/Task	- HR Manag.	- HR Planning
	(e)	CAMO.A.125 (e) CAMO.A.125 (f)	Support	Process/Task	- HR Manag.	- HR Planning - HR Recruitment
	(f)	CAMO.A.125 (d)(4)	Support	Process/Task	- HR Manag.	- HR Planning - HR Recruitment
	(g)	N/A	Support	Process/Task	- HR Manag.	N/A
CAMO.A.310 Airworthiness review staff qualifications	(a)(1)	CAMO.A.125 (e) CAMO.A.125 (f)	Support	Doc./Record	- HR Manag.	N/A
	(a)(2)	N/A	Support	Doc./Record	- HR Manag.	N/A
	(a)(3)	N/A	Support	Doc./Record	- HR Manag.	N/A
	(a)(4)	N/A	Support	Doc./Record	- HR Manag.	N/A
	(b)	CAMO.A.305 (a)(2)	Support	Doc./Record	- HR Manag.	N/A
	(c)	N/A	Support	Process/Task	- HR Manag.	- HR Recruitment
	(d)	N/A	Support	Doc./Record	- HR Manag.	- HR Planning - HR Recruitment - HR Qualification Control
CAMO.A.315 Continuing airworthiness management	(a)	M.A.301 M.A.302 M.A.303 M.A.304 M.A.305 M.A.306	Manag./Core	Process/Task	- Compliance Manag. - Aircraft Manag. - AW Data Manag.	- Findings Manag. - Operation Control - Pre-Flight Inspection - Maintenance Control - Data Manag. - AMP Manag. - Configuration Manag. - AD Manag.
	(b)(1)	M.A.302	Core	Process/Task	- AW Data Manag.	- Reliability Manag. - AMP Manag.
	(b)(2)	N/A	General Requirement		N/A	N/A
	(b)(3)	M.A.304	Core	Process/Task	- AW Data Manag.	- Reliability Manag. - AMP Manag.
	(b)(4)	CAMO.A.200(a)(3)	Core	Process/Task	- AW Data Manag.	- AMP Manag.
	(b)(5)	N/A	Core/ Support	Process/Task	- Aircraft Manag. - Procurement	- Maintenance Planning

Requirement #.#		Related Requirement	Requirement Classification		Level 1 Process	Level 2 Process
						- Contracting/ Subcontracting
	(b)(6)	N/A	Core/ Support	Process/Task	- Aircraft Manag. - Procurement	- Maintenance Planning - Contracting/ Subcontracting
	(c)(1)	N/A	Core/ Support	Process/Task	- Aircraft Manag. - Procurement	- Maintenance Planning - Contracting/ Subcontracting
	(c)(2)	N/A	Core/ Support	Process/Task	- Aircraft Manag. - Procurement	Maintenance Planning Contracting/ Subcontracting
	(d)(1)	N/A	Support	Process/Task	- Procurement	Contracting/ Subcontracting
	(d)(2)	N/A	Support	Process/Task	- Procurement	Contracting/ Subcontracting
	(e)	N/A	General Requirement		N/A	N/A
CAMO.A.320 Airworthiness review	-	M.A.901	Core	Process/Task	- HR Manag.	- HR Planning - HR Recruitment - HR Qualification Control
CAMO.A.325 Continuing airworthiness management data	-	N/A	General Requirement		N/A	N/A
M.A.301 Continuing airworthiness tasks	(a)	N/A	Core	Process/Task	- Aircraft Manag.	- Pre-Flight Inspection
	(b)	N/A	Core	Process/Task	- Aircraft Manag. - AW Data Manag.	- Operation Control - Maintenance Control - Configuration Manag.
	(c)	M.A.302	Core	Process/Task	- Aircraft Manag.	- Operation Control - Maintenance Control
	(d)	Subpart H CRS	Core	Process/Task	- Aircraft Manag	-Maintenance Control
	(e)	M.A.302	Core	Process/Task	- Aircraft Manag	-Maintenance Control
	(f)(1)	N/A	Core	Process/Task	- Aircraft Manag. - AW Data Manag.	- Operation Control - Maintenance Control

Requirement #.#		Related Requirement	Requirement Classification		Level 1 Process	Level 2 Process
						- AD Manag.
	(f)(2)	N/A	Core	Process/Task	- Aircraft Manag. - AW Data Manag.	- Operation Control - Maintenance Control - AD Manag.
	(f)(3)	N/A	Core	Process/Task	- Aircraft Manag. - AW Data Manag.	- Operation Control - Maintenance Control - AD Manag.
	(f)(4)	N/A	Core	Process/Task	- Compliance Manag. - Aircraft Manag. - AW Data Manag.	- Operation Control - Findings Manag. - Maintenance Control - AD Manag.
	(g)	M.A.304	Core	Process/Task	- Aircraft Manag. - AW Data Manag.	- Operation Control - Maintenance Control - AD Manag.
	(h)	N/A	Core	Process/Task	- Aircraft Manag.	- Operation Control - Maintenance Control
	(i)	N/A	Core	Process/Task	- Aircraft Manag.	- Operation Control - Maintenance Control
M.A.302 Aircraft maintenance programme	(a)	N/A	General Requirement		N/A	N/A
	(b)	N/A	Core	Process/Task	- AW Data Manag.	- AMP Manag.
	(c)	N/A	Core	Process/Task	- AW Data Manag.	- AMP Manag.
	(d)(1)	N/A	Core	Doc./Record	- AW Data Manag.	- AMP Manag.
	(d)(2)(i)	N/A	Core	Doc./Record	- AW Data Manag.	- AMP Manag.
	(d)(2)(ii)	N/A	Core	Doc./Record	- AW Data Manag.	- AMP Manag.
	(e)	N/A	Core	Process/Task	- AW Data Manag.	- AMP Manag.
	(f)	N/A	Core	Doc./Record	- AW Data Manag.	- AMP Manag.
	(g)	N/A	Core	Doc./Record	- AW Data Manag.	- AMP Manag. - Reliability Manag.

Requirement #.#		Related Requirement	Requirement Classification		Level 1 Process	Level 2 Process
	(h)	N/A	Core	Process/Task	- AW Data Manag.	- AMP Manag.
M.A.303 Airworthiness directives	-	N/A	Core	Process/Task	- AW Data Manag.	- AD Manag.
M.A.304 Data for modifications and repairs	(a)	N/A	Core	Process/Task	- Aircraft Manag. - AW Data Manag.	- Maintenance Control - Data Manag.
	(b)	N/A	Core	Process/Task	- Aircraft Manag. - AW Data Manag.	- Maintenance Control - Data Manag.
	(c)	N/A	Core	Process/Task	- Aircraft Manag. - AW Data Manag.	- Maintenance Control - Data Manag.
M.A.305 Aircraft continuing airworthiness record system	(a)	M.A.801	Core	Process/Task Doc./Record	- Aircraft Manag.	- Maintenance Control
	(b)1.	N/A	Core	Doc./Record	- Aircraft Manag.	- Operation Control
	(b)2.	N/A	Core	Doc./Record	- Aircraft Manag.	- Operation Control
	(b)3.	M.A.306	Core	Doc./Record	- Aircraft Manag.	- Maintenance Control
	(c)1.	N/A	Core	Doc./Record	- Aircraft Manag. - AW Data Manag.	- Maintenance Control - AD Manag.
	(c)2.	N/A	Core	Doc./Record	- Aircraft Manag.	- Maintenance Control
	(c)3.	N/A	Core	Doc./Record	- Aircraft Manag.	- Maintenance Control
	(c)4.	N/A	Core	Doc./Record	-Aircraft Manag.	- Operation Control - Maintenance Control
	(d)1.	N/A	Core	Process/Task Doc./Record	- Aircraft Manag. - AW Data Manag.	- Operation Control - Maintenance Control - Configuration Manag.
	(d)2.	N/A	Core	Process/Task Doc./Record	- Aircraft Manag. - AW Data Manag.	- Operation Control - Maintenance Control - Configuration Manag.
	(e)1.	N/A	General Requirement		N/A	N/A
	(e)2.(i)	N/A	General Requirement		N/A	N/A
	(e)2.(ii)	N/A	General Requirement		N/A	N/A
	(e)2.(iii)	N/A	General Requirement		N/A	N/A

Requirement #.#		Related Requirement	Requirement Classification		Level 1 Process	Level 2 Process
	(e)3.(i)	N/A	General Requirement		N/A	N/A
	(e)3.(ii)	N/A	General Requirement		N/A	N/A
	(e)3.(iii)	N/A	General Requirement		N/A	N/A
	(e)4.(i)	N/A	General Requirement		N/A	N/A
	(e)4.(ii)	N/A	General Requirement		N/A	N/A
	(e)4.(iii)	N/A	General Requirement		N/A	N/A
	(f)	N/A	General Requirement		N/A	N/A
	(g)	N/A	General Requirement		N/A	N/A
M.A.306 Aircraft technical log system	(a)1.	N/A	Core	Doc./Record	- Aircraft Manag.	- Operation Control - Maintenance Control
	(a)2.	N/A	Core	Doc./Record	- Aircraft Manag.	- Operation Control - Maintenance Control
	(a)3.	N/A	Core	Doc./Record	- Aircraft Manag.	- Operation Control - Maintenance Control
	(a)4.	N/A	Core	Doc./Record	- Aircraft Manag.	- Operation Control - Maintenance Control
	(a)5.	N/A	Core	Doc./Record	- Aircraft Manag.	- Operation Control - Maintenance Control
	(b)	N/A	General Requirement		N/A	N/A
M.A.307 Transfer of aircraft continuing airworthiness records	(a)	M.A.903 M.A.904	Core	Process/task	- AW Data Manag.	- Aircraft AW transfer
	(b)	N/A	General Requirement		N/A	N/A
	(c)	N/A	General Requirement		N/A	N/A
M.A.901 Aircraft airworthiness review	(a)	N/A	Core	Process/task Doc./Record	- AW Review Manag.	- AW Review Evaluation
	(b)1.	N/A	General Requirement		N/A	N/A
	(b)2.	M.A.801 M.A.803	General Requirement		N/A	N/A
	(c)1.	N/A	Core	Process/task	- AW Review Manag.	- AW Review Evaluation
	(c)2.	N/A	Core	Process/task	- AW Review Manag.	- AW Review Evaluation
	(d)1.	N/A	Core	Process/task	- AW Review Manag.	- AW Review Evaluation
	(d)2.	M.A.901	Core	Process/task	- AW Review Manag.	- AW Review Evaluation

Requirement #.#		Related Requirement	Requirement Classification		Level 1 Process	Level 2 Process
	(e)1.	N/A	Core	Process/task	- AW Review Manag.	- AW Review Evaluation
	(e)2.	N/A	Core	Process/task	- AW Review Manag.	- AW Review Evaluation
	(f)	M.A.901 (c)(2) M.A.901 (e)(2)	General Requirement		N/A	N/A
	(g)	N/A	General Requirement		N/A	N/A
	(h)1.	N/A	General Requirement		N/A	N/A
	(h)2.	N/A	General Requirement		N/A	N/A
	(i)1.	N/A	General Requirement		N/A	N/A
	(i)2.	N/A	General Requirement		N/A	N/A
	(i)3.	N/A	General Requirement		N/A	N/A
	(j)	N/A	General Requirement		N/A	N/A
	(k)1.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(k)2.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(k)3.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(k)4.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(k)5.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(k)6.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(k)7.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(k)8.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(k)9.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(k)10.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(k)11.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(l)	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(m)1.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(m)2.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(m)3.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(m)4.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(m)5.	N/A	Core	Process/task	-AW Review Manag.	- AW Review Issuance
	(n)	N/A	General Requirement		N/A	N/A

Requirement #.#		Related Requirement	Requirement Classification		Level 1 Process	Level 2 Process
	(o)1.	N/A	Core	Process/task	- AW Review Manag.	AW Review Issuance
	(o)2.	N/A	Core	Process/task	- AW Review Manag.	AW Review Issuance
	(p)	N/A	Core	Process/task	- AW Review Manag.	- AW Review Issuance - AW Review Data Update
	(q)	N/A	General Requirement		N/A	N/A
	(r)	N/A	General Requirement		N/A	N/A
	(s)	N/A	Core	Process/task	- AW Review Manag.	AW Review Issuance
M.A.903 Transfer of aircraft registration within the EU	(a)1.	N/A	Core	Process/task	- AW Data Manag.	- Aircraft AW transfer
	(a)2.	N/A	Core	Process/task	- AW Data Manag.	- Aircraft AW transfer
	(b)	N/A	General Requirement		N/A	N/A
M.A.904 Airworthiness review of aircraft imported into the EU	(a)1.	N/A	Core	Process/task	- AW Data Manag.	- Aircraft AW transfer
	(a)2.	N/A	Core	Process/task	- AW Data Manag.	- Aircraft AW transfer
	(a)3.	N/A	Core	Process/task	- AW Data Manag.	Aircraft AW transfer
	(b)	N/A	Core	Process/task	- AW Data Manag.	- Aircraft AW transfer
	(c)	N/A	General Requirement		N/A	N/A
	(d)	N/A	General Requirement		N/A	N/A
	(e)	N/A	General Requirement		N/A	N/A

Description:

Part CAMO Requirements	Part M Requirements

APPENDIX A - LEVEL 3 BPMN PROCESSES

Process Level 1	**1 - Strategic Management**
Process Level 2	**1.1 - Documental Management**

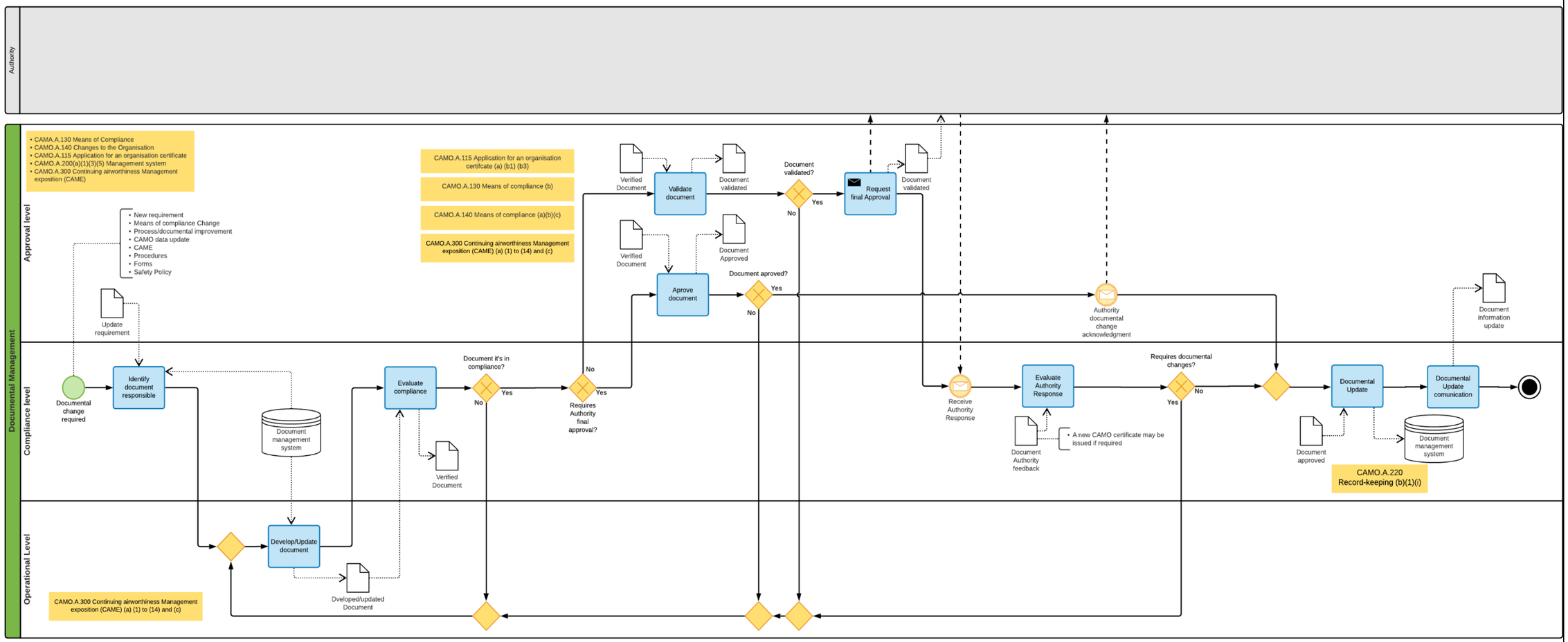


Figure 31 - BPMN Documental Management process

Process Level 1	1 - Strategic Management
Process Level 2	1.2 - Risk Management

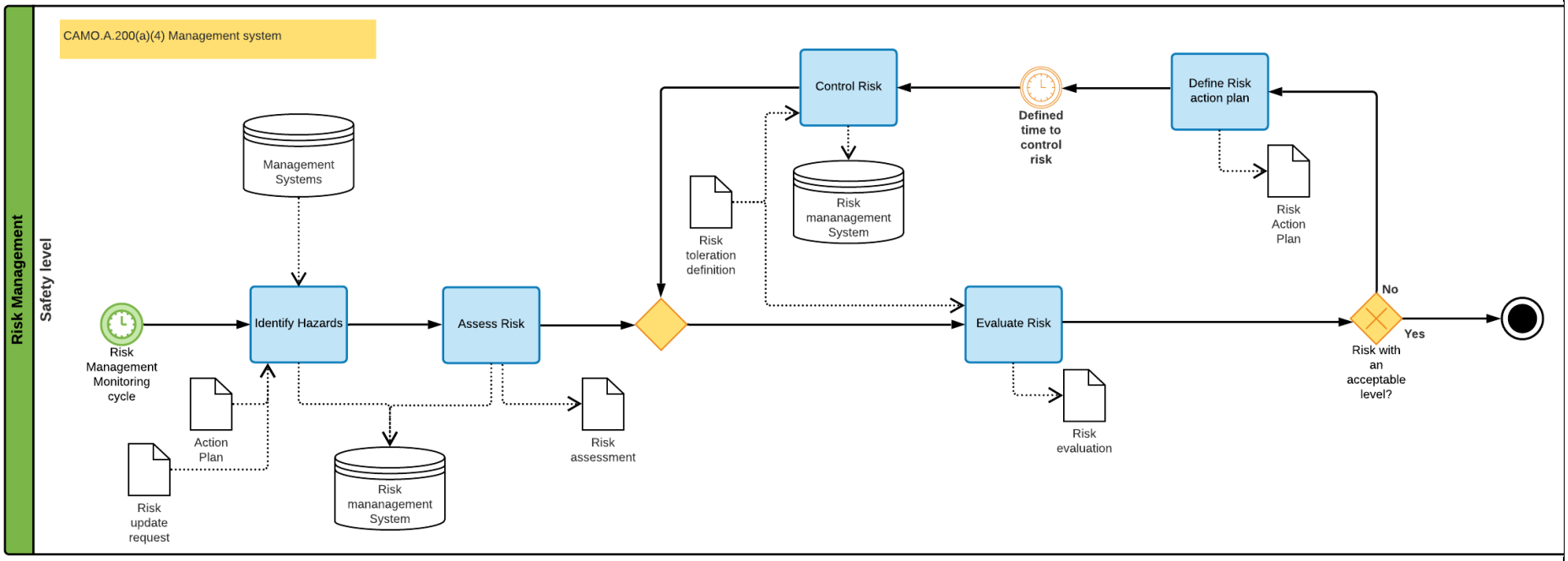


Figure 32 - BPMN Risk Management Process

Process Level 1	1 - Strategic Management
Process Level 2	1.3 - System Monitoring

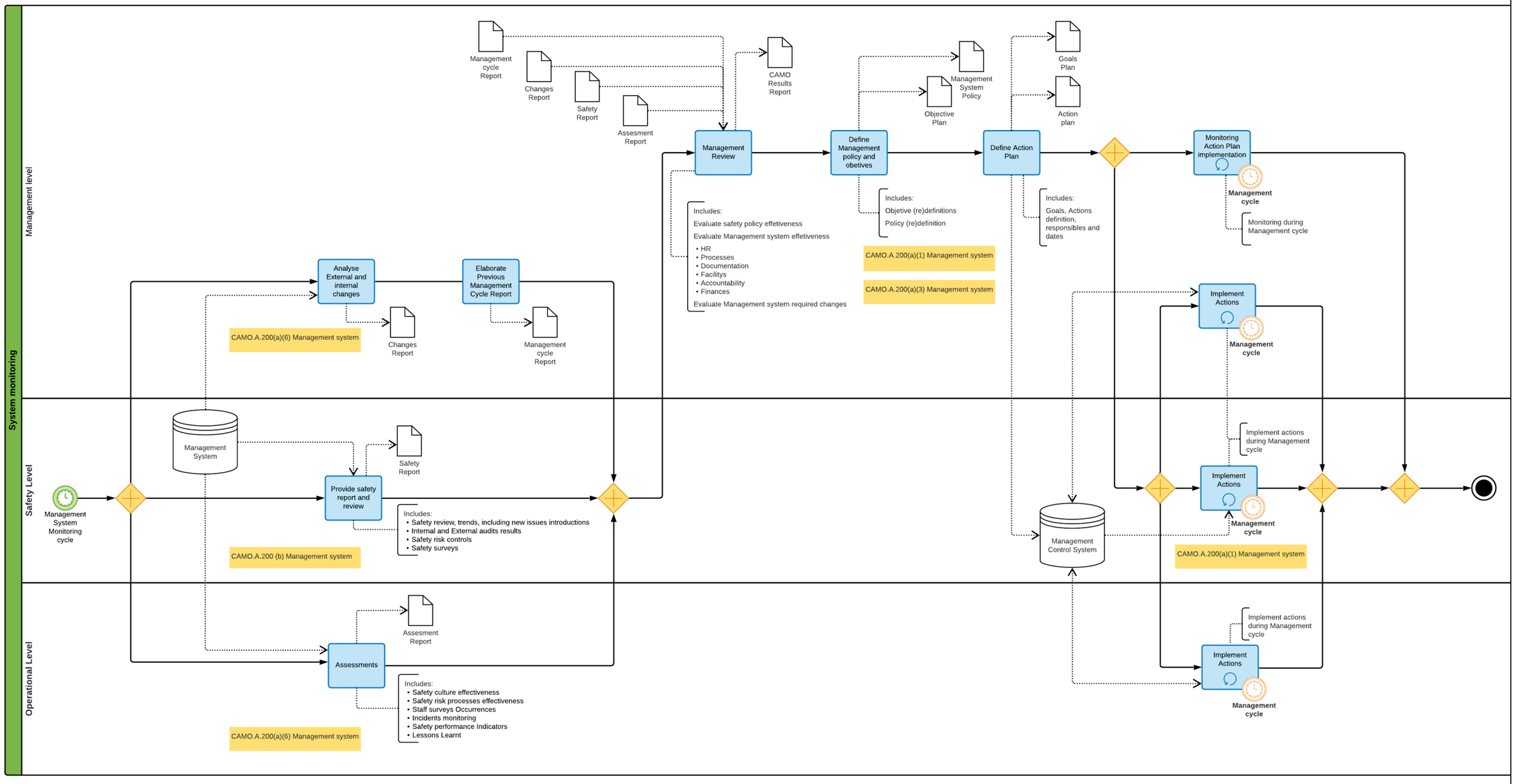


Figure 33 - BPMN System Monitoring Process

Process Level 1	2 - Compliance Management
Process Level 2	2.1 - Audit Management

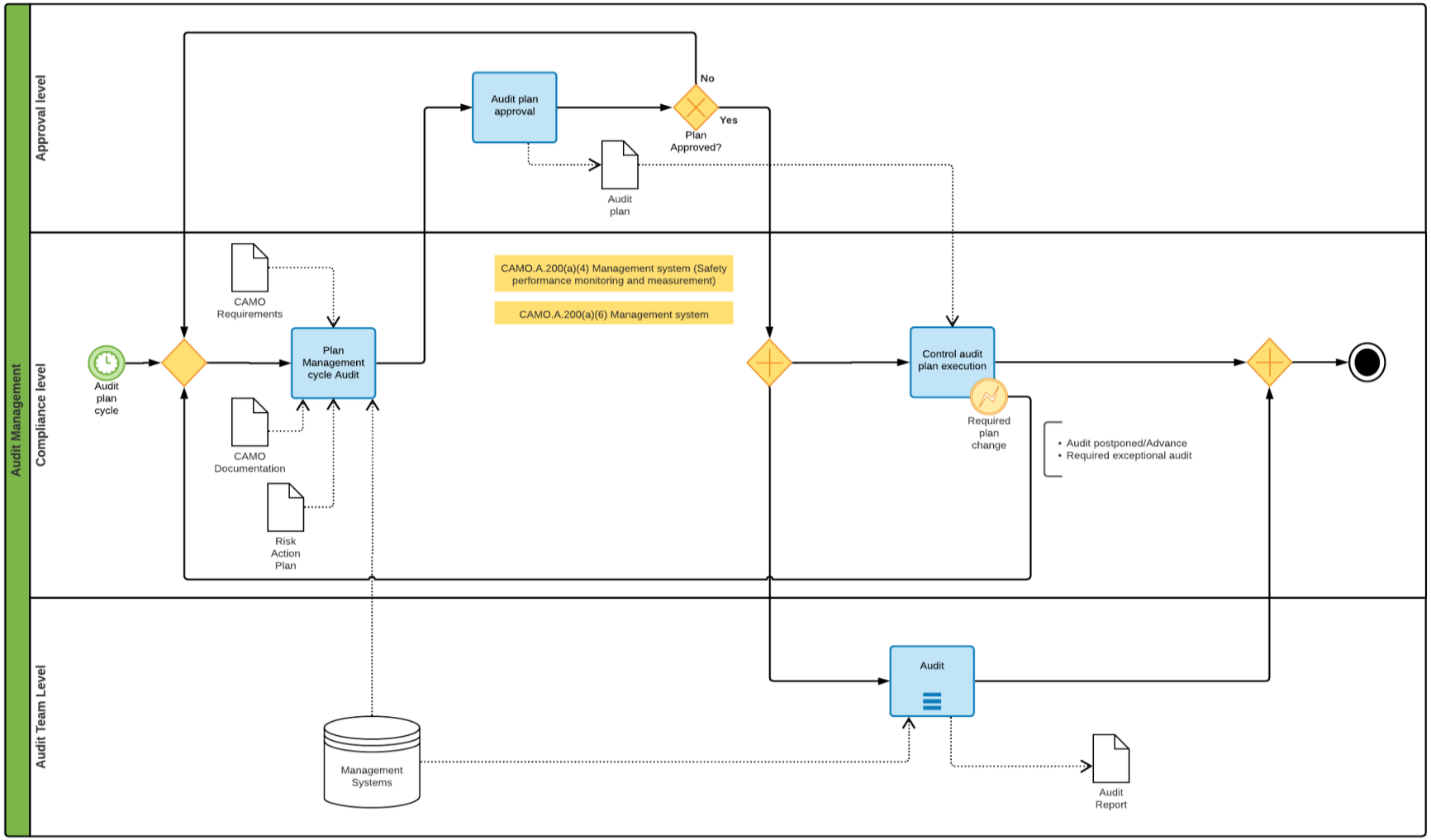


Figure 34 - BPMN Audit Management Process

Process Level 1	2 - Compliance Management
Process Level 2	2.2 - Finding Management

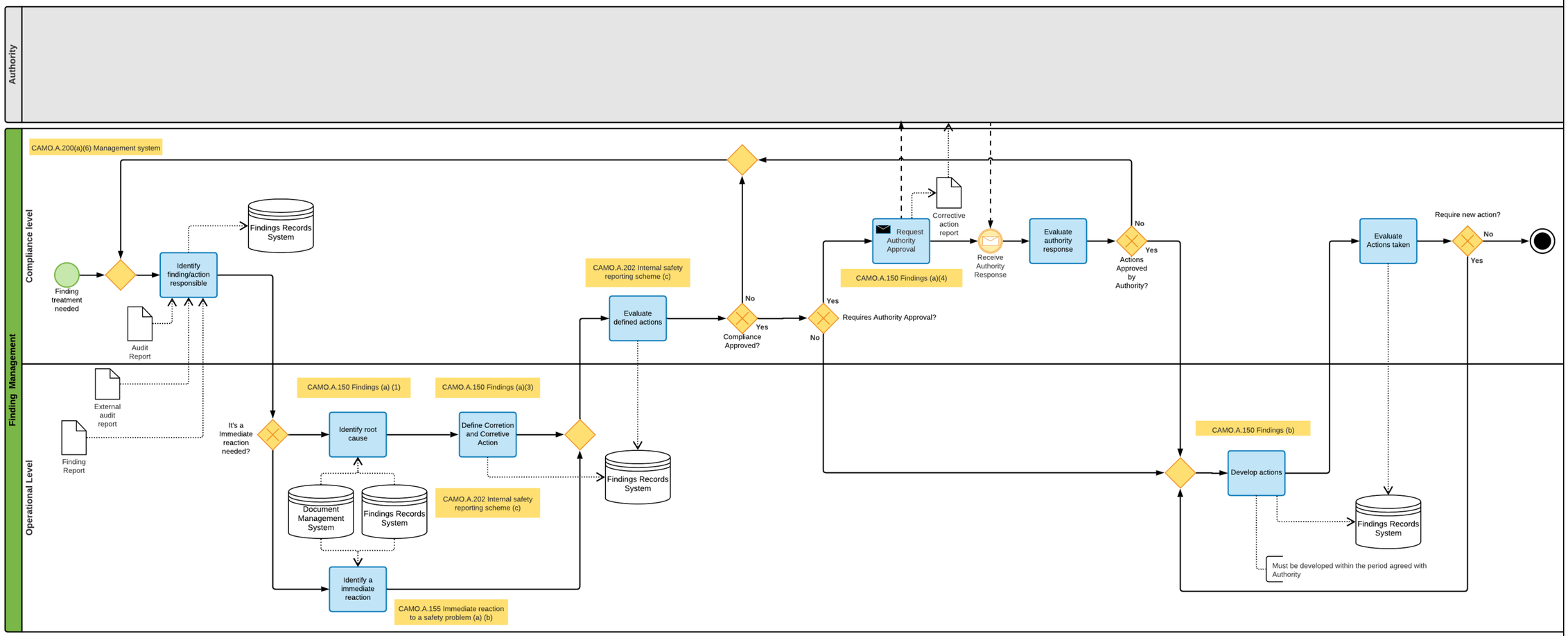


Figure 35 - BPMN Finding Management process

Process Level 1	2 - Compliance Management
Process Level 2	2.3 - Internal Reporting

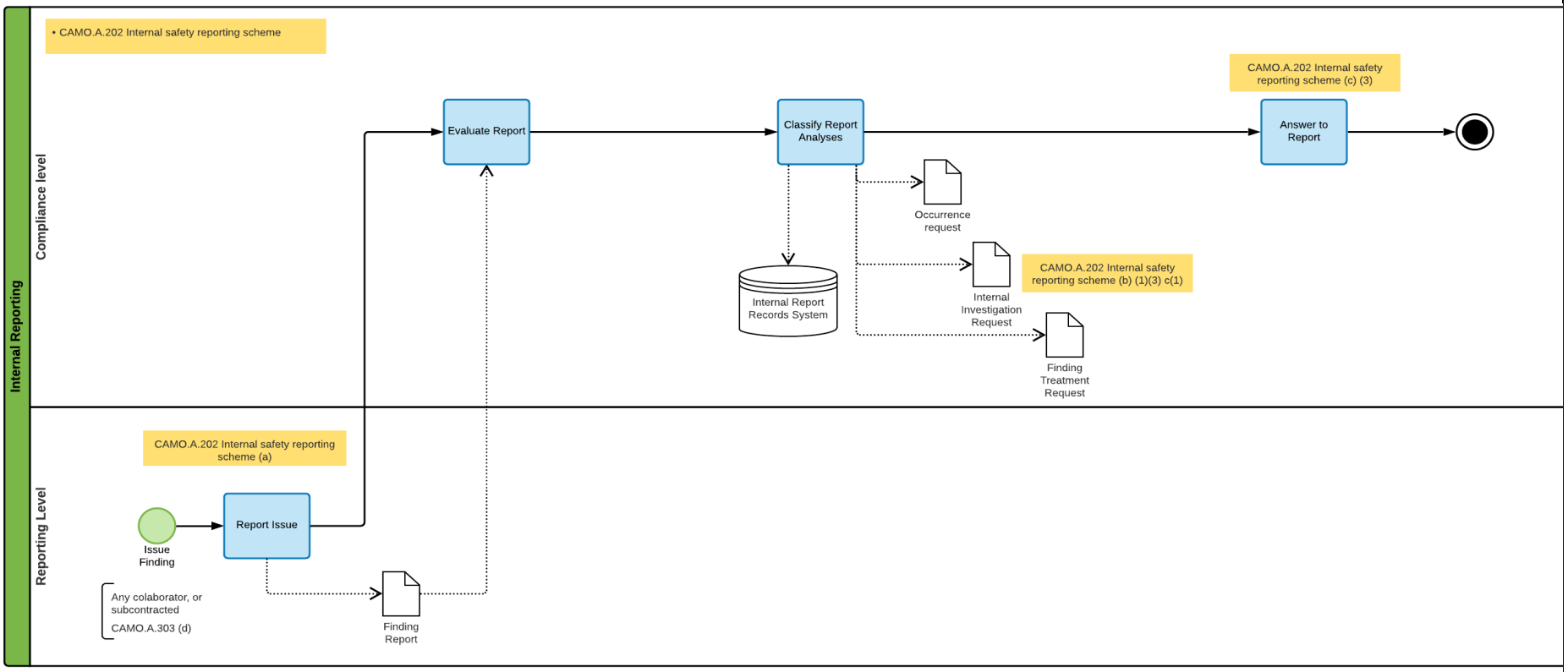


Figure 36 - BPMN Internal Reporting Process

Process Level 1	2 - Compliance Management
Process Level 2	2.4 - Internal Investigation

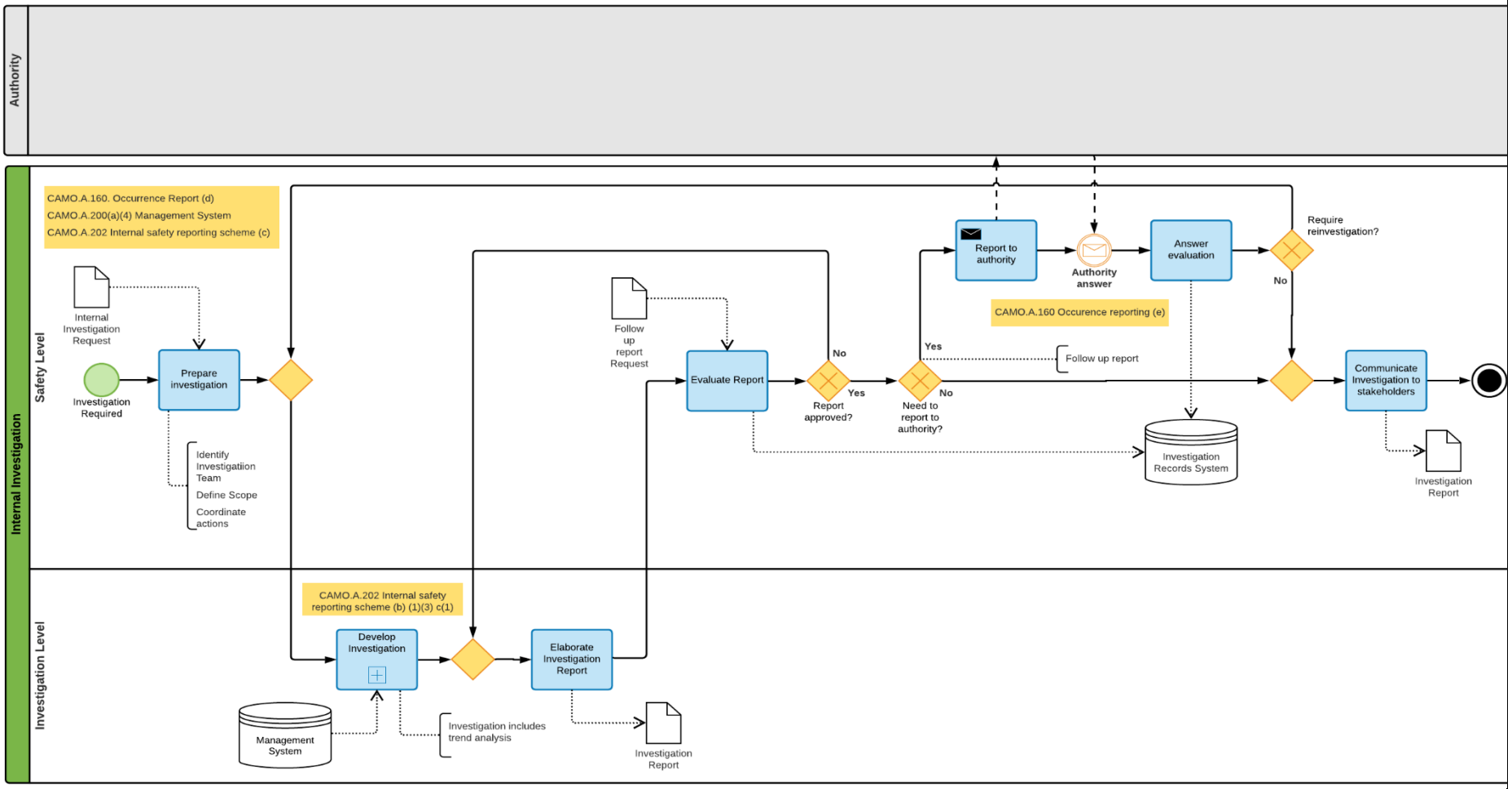


Figure 37 - BPMN Internal Investigation Process

Process Level 1	2 - Compliance Management
Process Level 2	2.5 - Occurrence Reporting

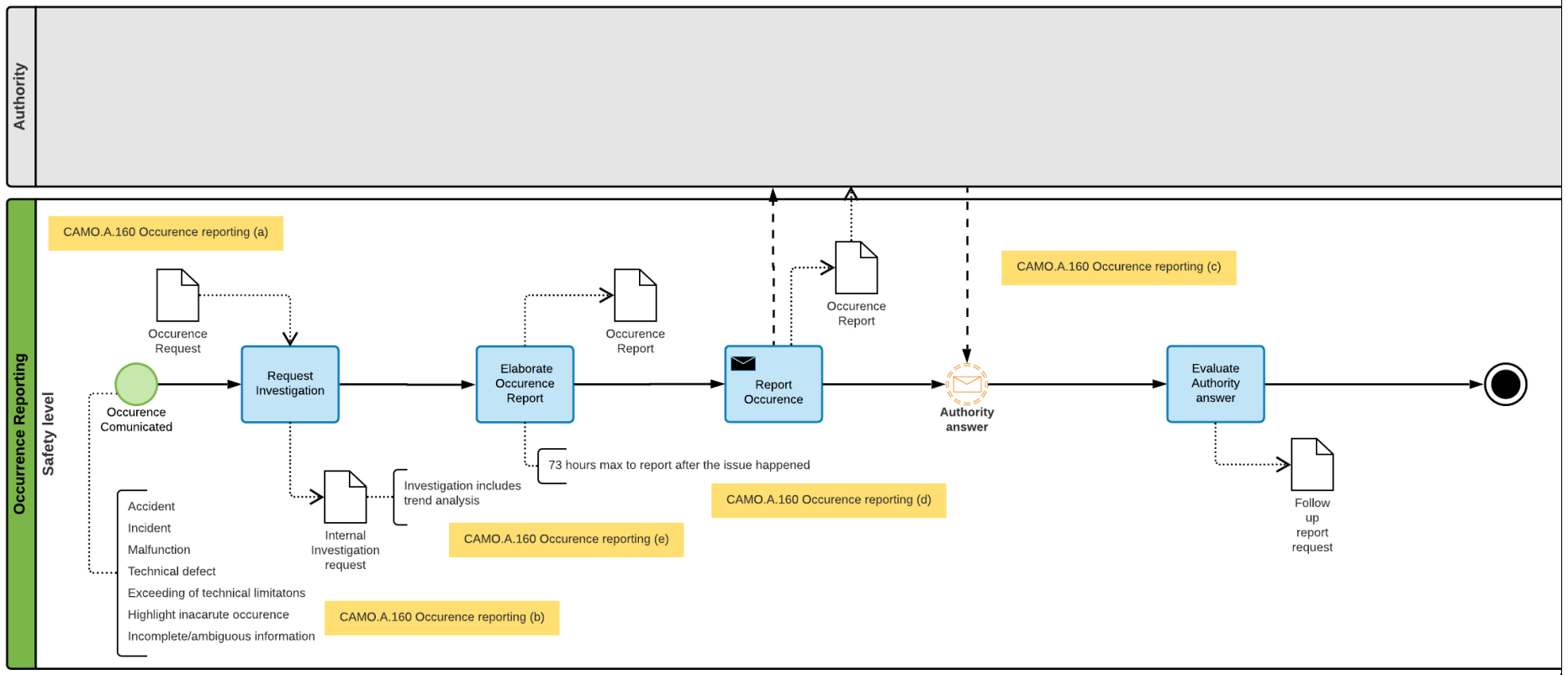


Figure 38 - BPMN Occurrence Reporting Process

Process Level 1	3 - Aircraft Management
Process Level 2	3.1 - Operation Control

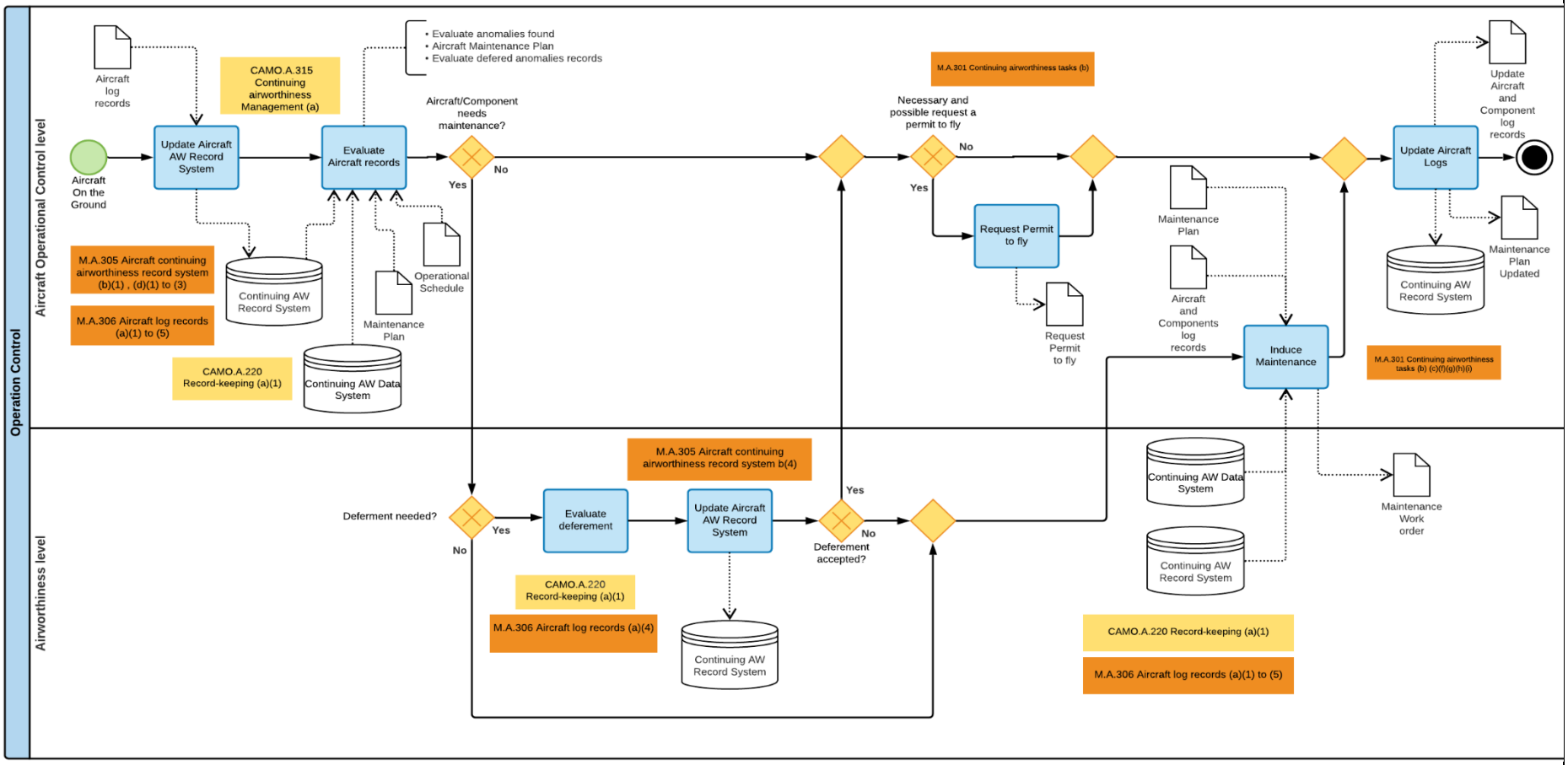


Figure 39 - BPMN Operation Control Process

Process Level 1	3 - Aircraft Management
Process Level 2	3.2 - Pre-Flight Inspection

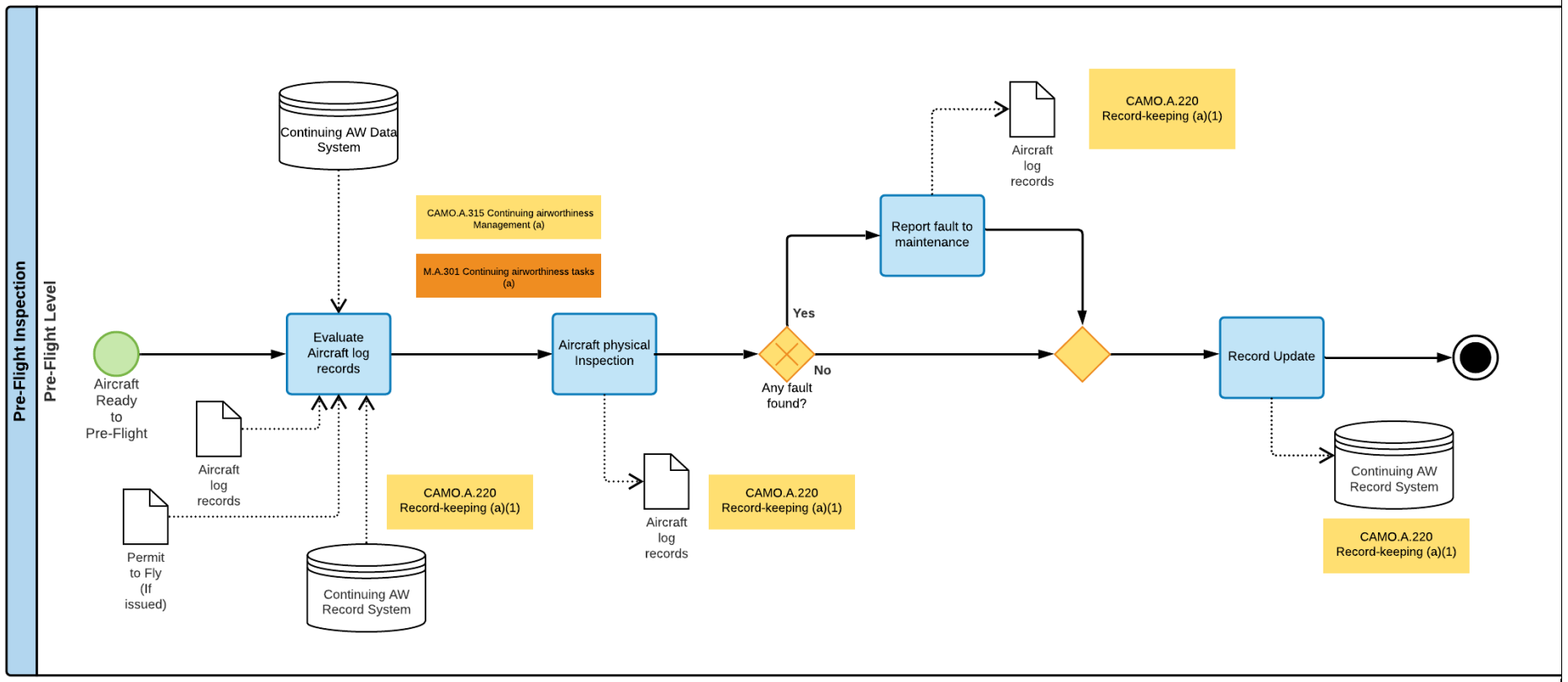


Figure 40 - BPMN Pre-Flight Inspection Process

Process Level 1	3 - Aircraft Management
Process Level 2	3.3 - Maintenance Control

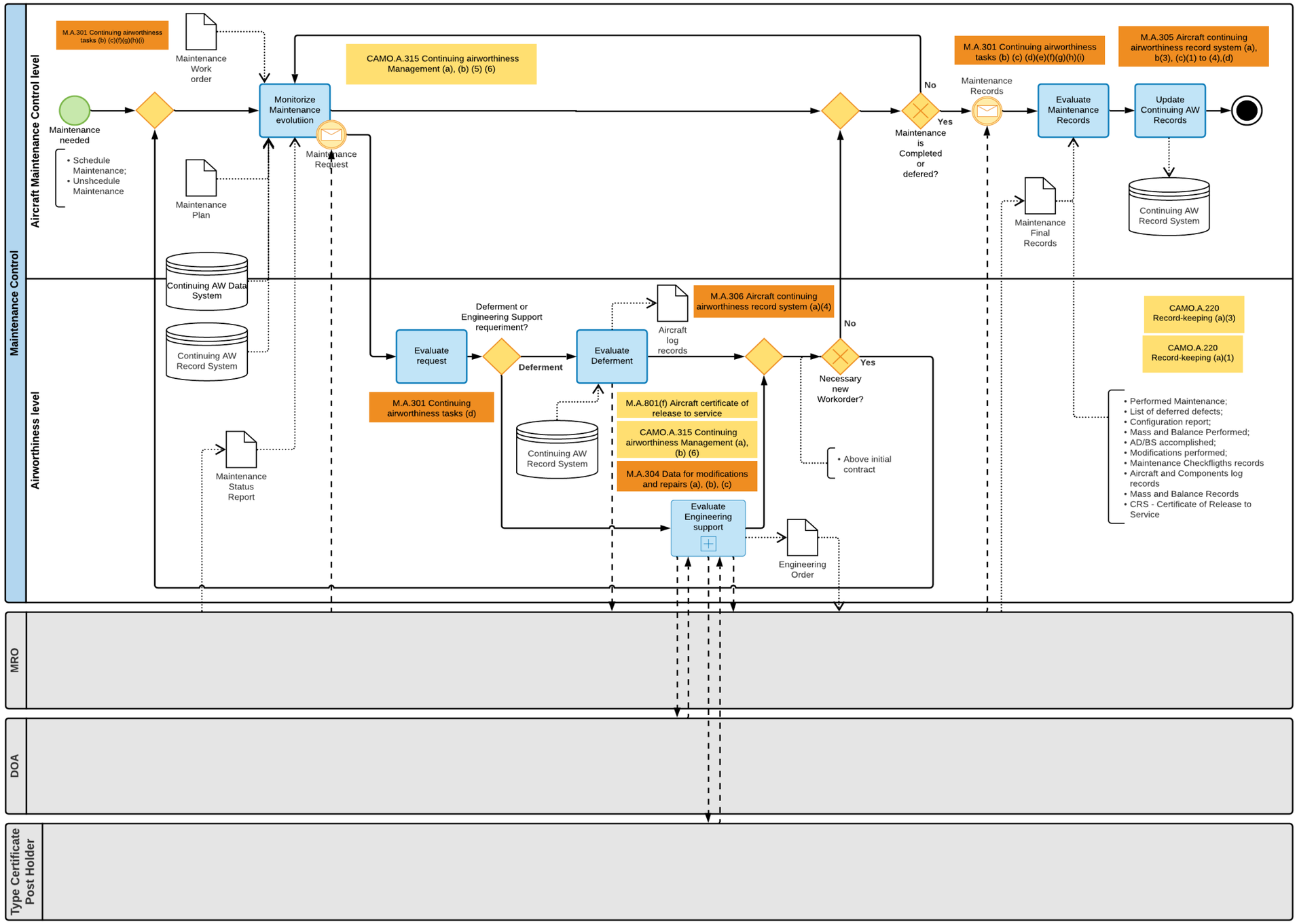


Figure 41 - BPMN Maintenance Control Process

Process Level 1	3 - Aircraft Management
Process Level 2	3.4 - Maintenance Planning

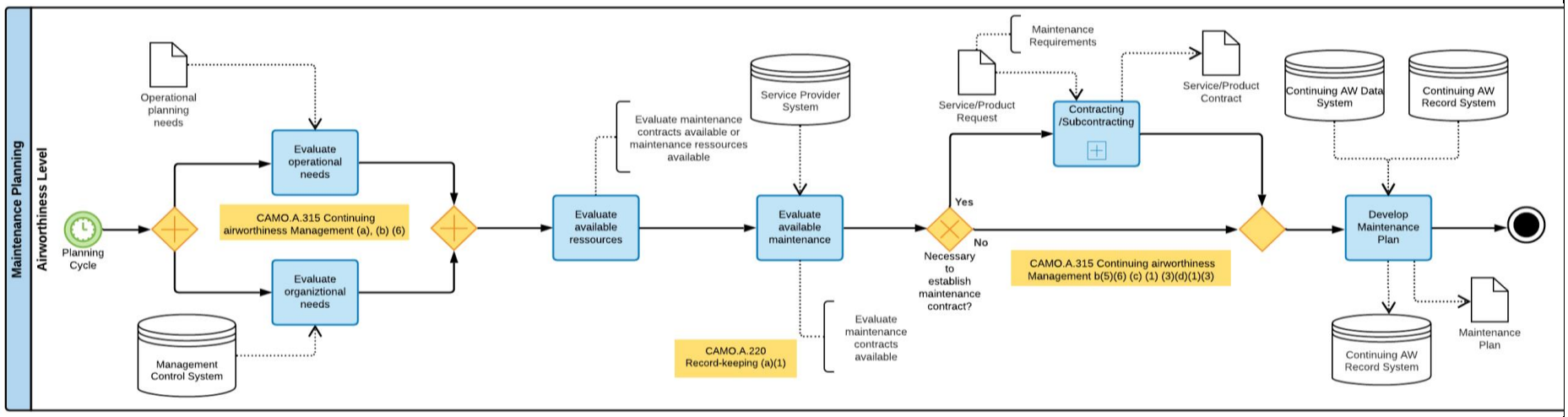


Figure 42 - BPMN Maintenance Planning Process

Process Level 1	3 - Aircraft Management
Process Level 2	3.5 - Permit to Fly Issuance

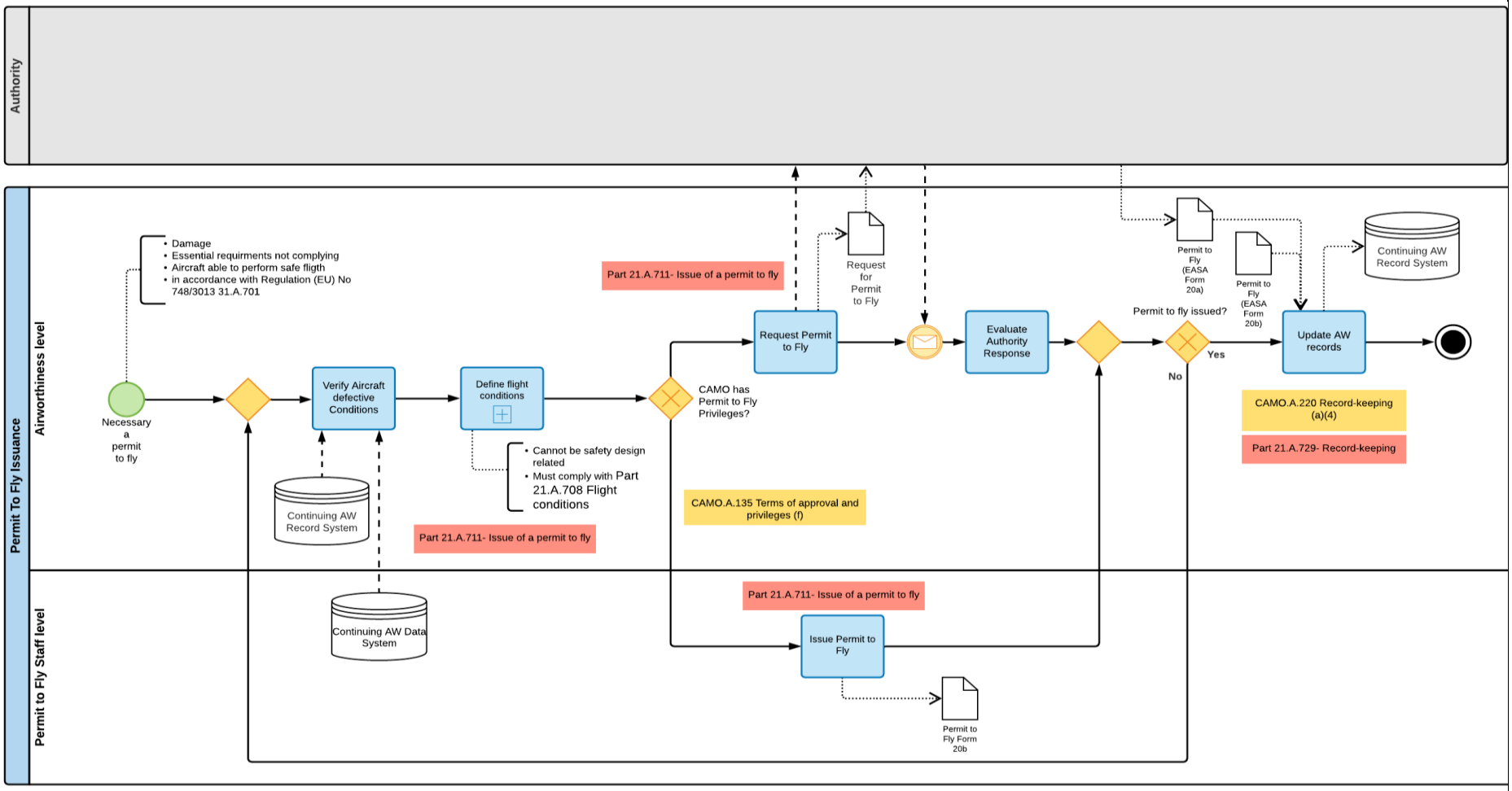


Figure 43 - BPMN Permit to Fly Issuance Process

Process Level 1	4 - Airworthiness Data Management
Process Level 2	4.1 - Data Management

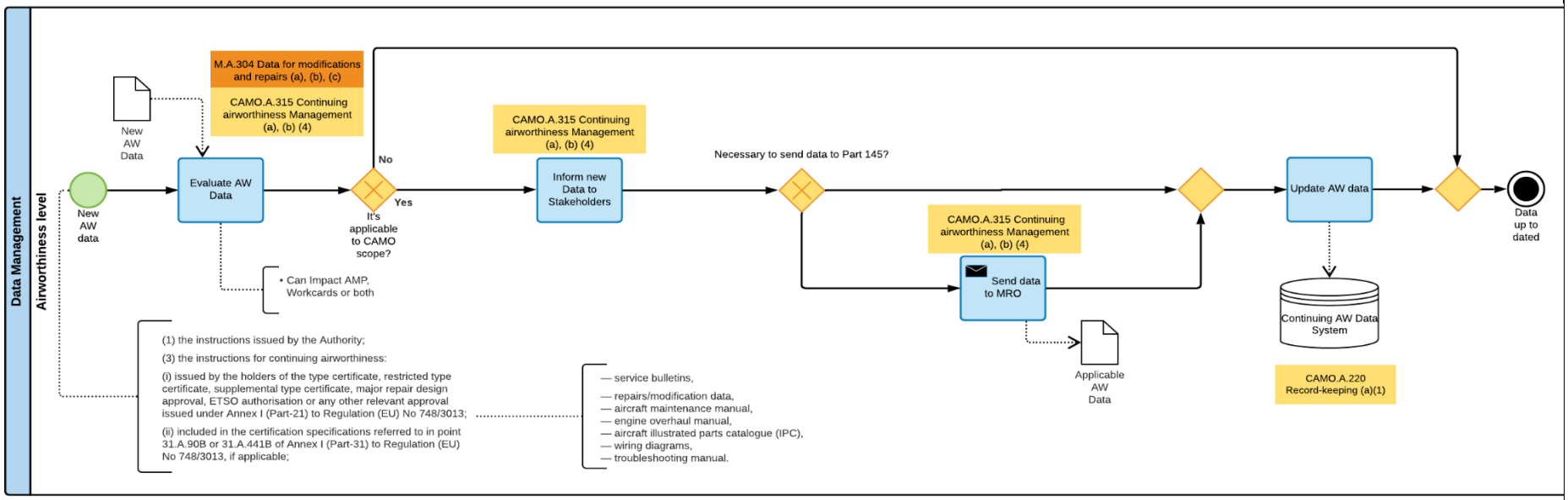


Figure 44 - BPMN Data Management Process

Process Level 1	4 - Airworthiness Data Management
Process Level 2	4.2 - Reliability Management

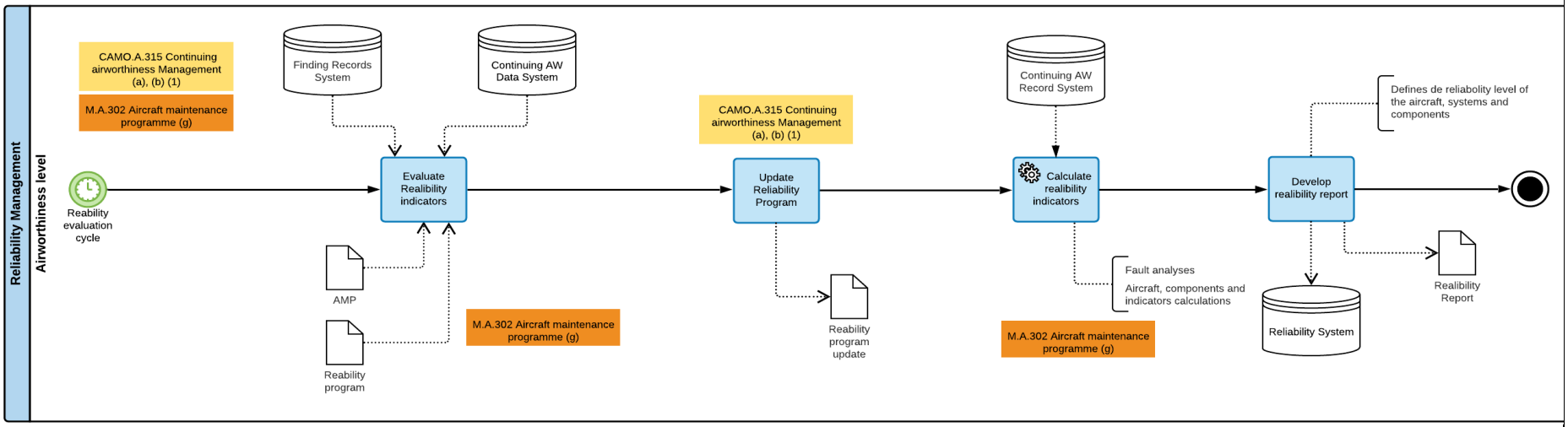


Figure 45 - BPMN Reliability Management Process

Process Level 1	4 - Airworthiness Data Management
Process Level 2	4.3 - Aircraft Maintenance Program Management

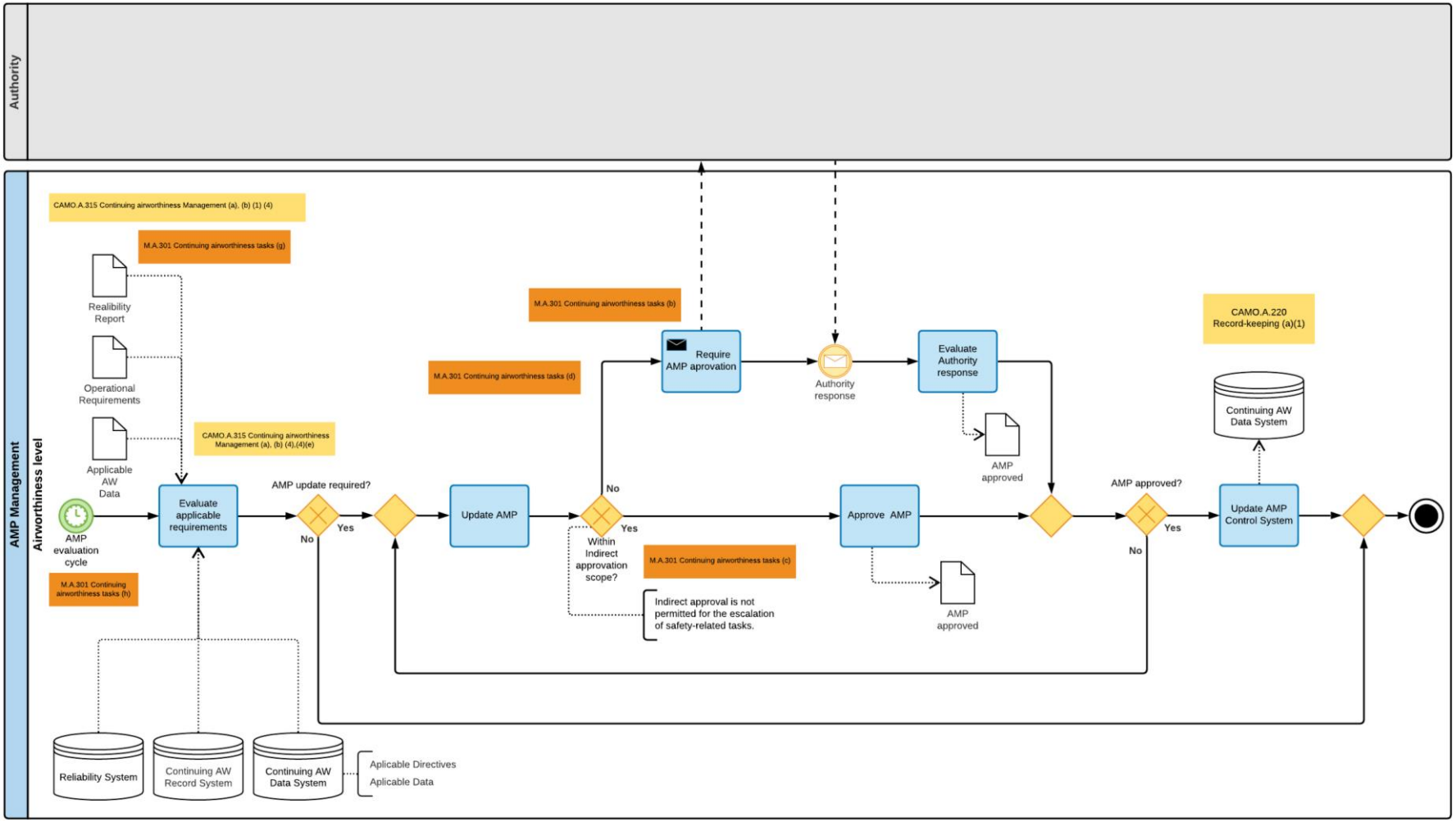


Figure 46 - BPMN Aircraft Maintenance Program Management Process

Process Level 1	4 - Airworthiness Data Management
Process Level 2	4.4 - Directives Management

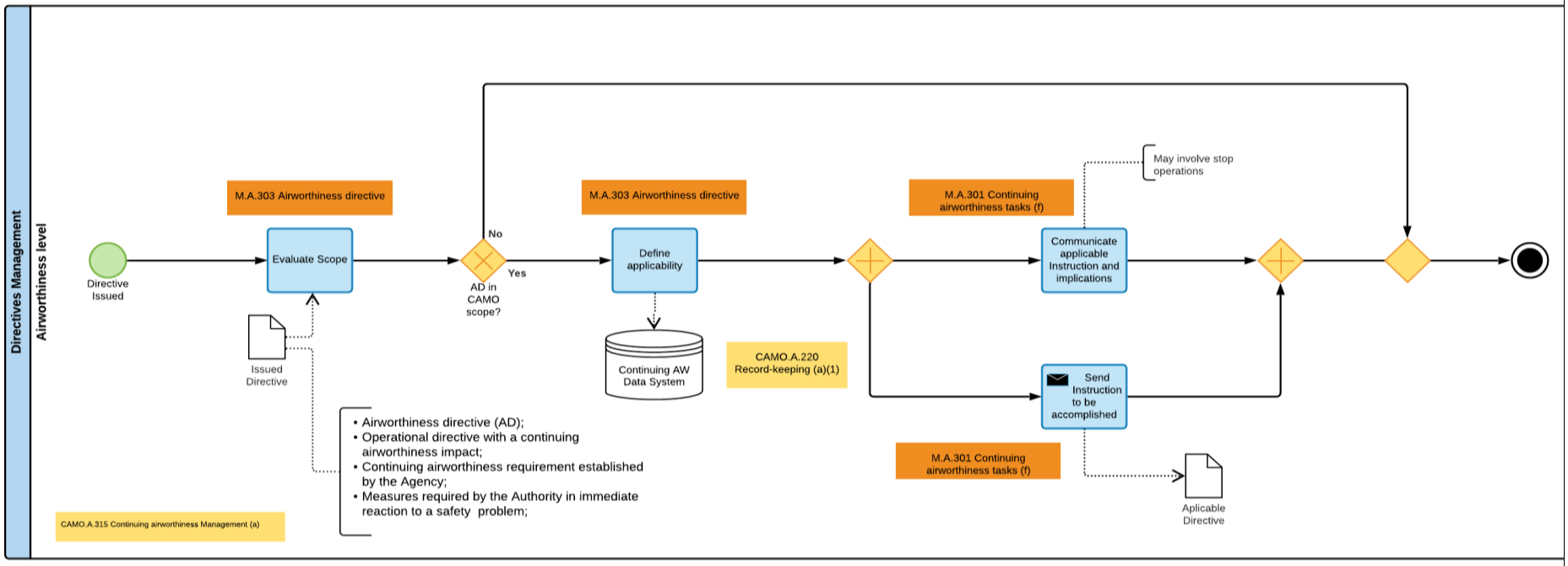


Figure 47 - BPMN Directives Management Process

Process Level 1	4 - Airworthiness Data Management
Process Level 2	4.5 - Configuration Management

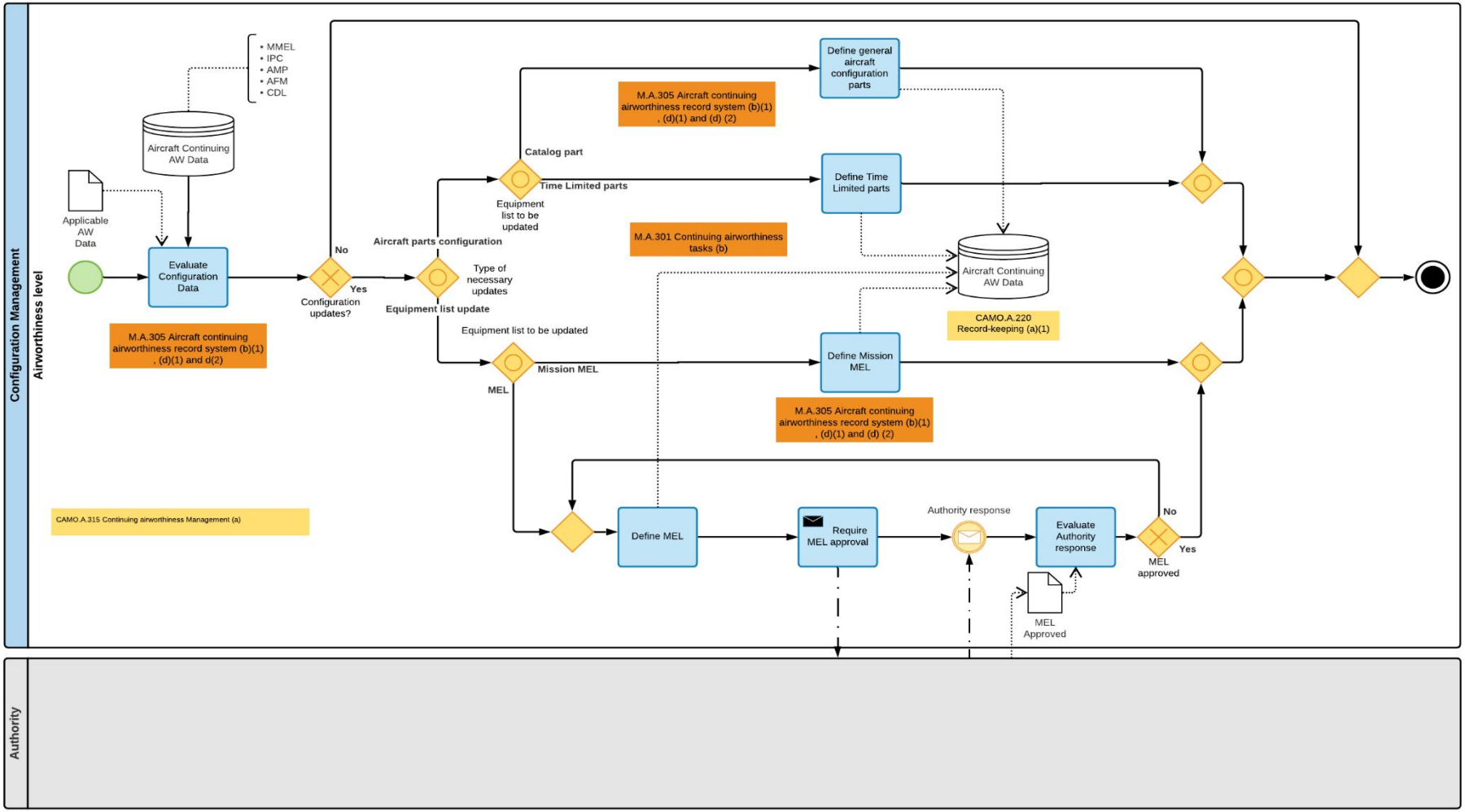


Figure 48 - BPMN Configuration Management Process

Process Level 1	4 - Airworthiness Data Management
Process Level 2	4.6 - Aircraft Airworthiness Transfer

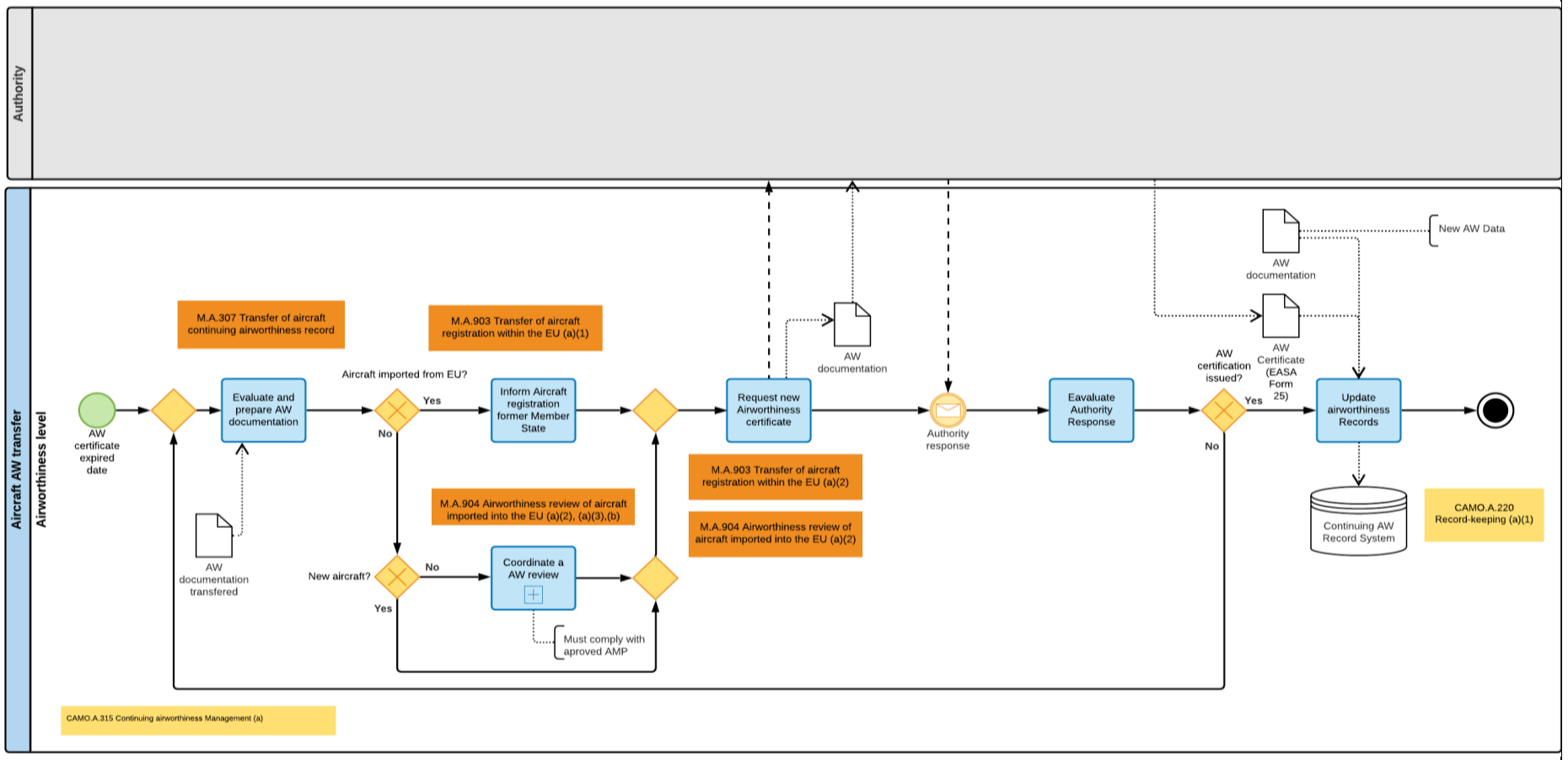


Figure 49 - BPMN Aircraft Airworthiness Transfer Process

Process Level 1	5 - Airworthiness Review Management
Process Level 2	5.1 - Airworthiness Review Evaluation

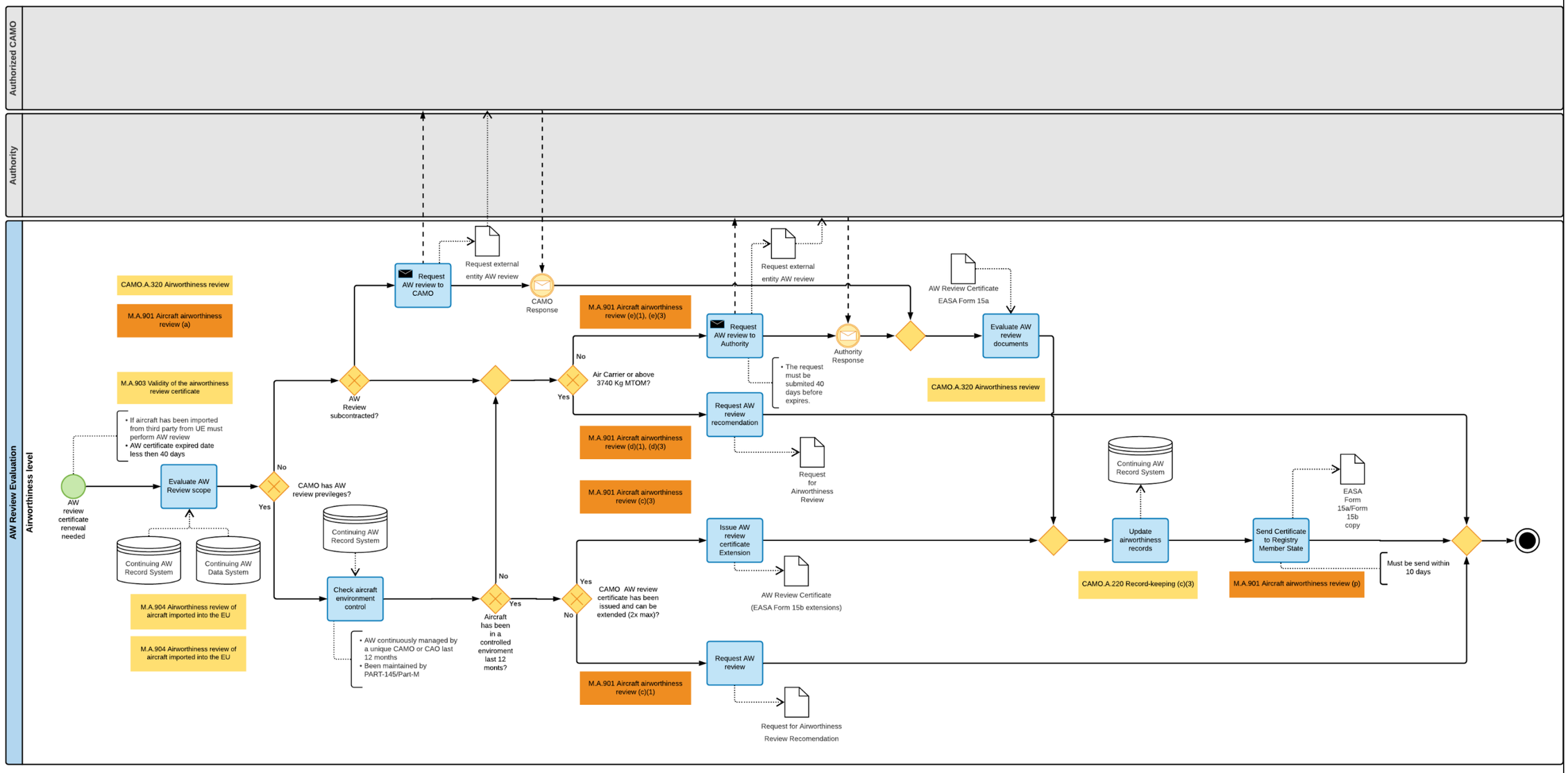


Figure 50 - BPMN Airworthiness Review Evaluation process

Process Level 1	5 - Airworthiness Review Management
Process Level 2	5.2 - Airworthiness Review Issuance

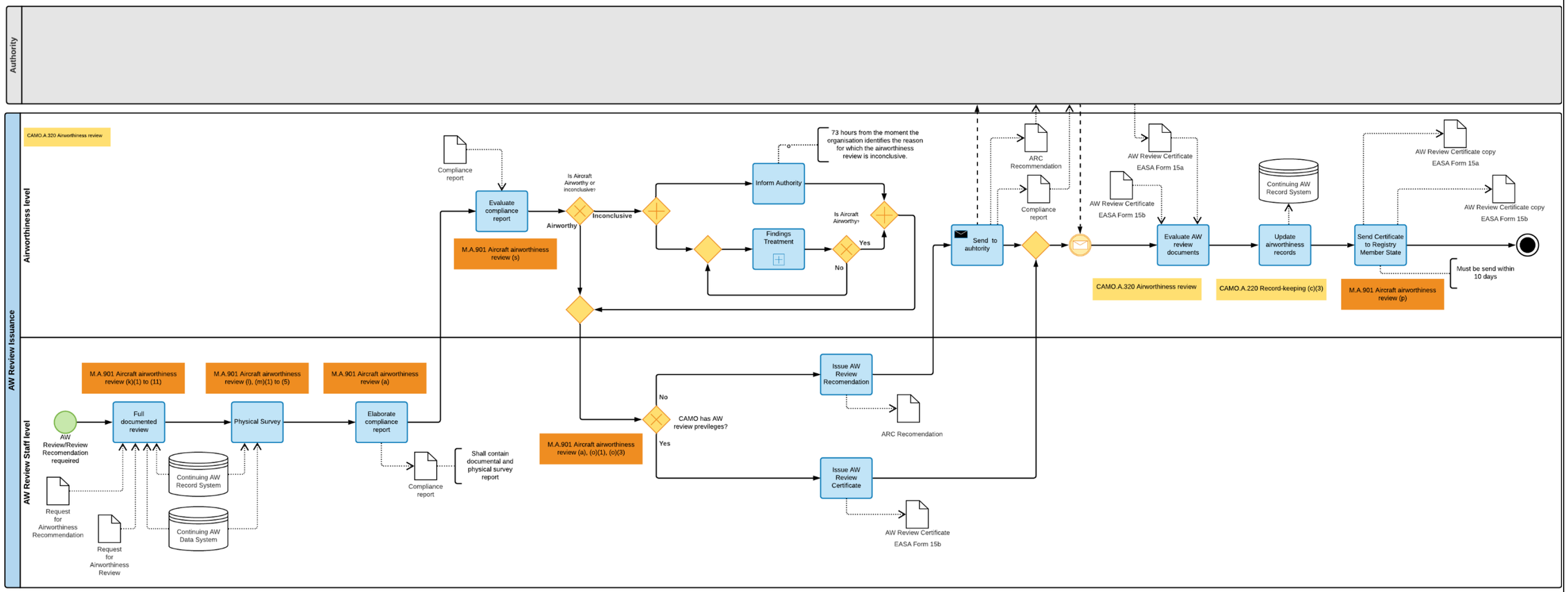


Figure 51 - BPMN Airworthiness Review Issuance process

Process Level 1	6 - Human Resources Management
Process Level 2	6.1 - Human Resources Planning

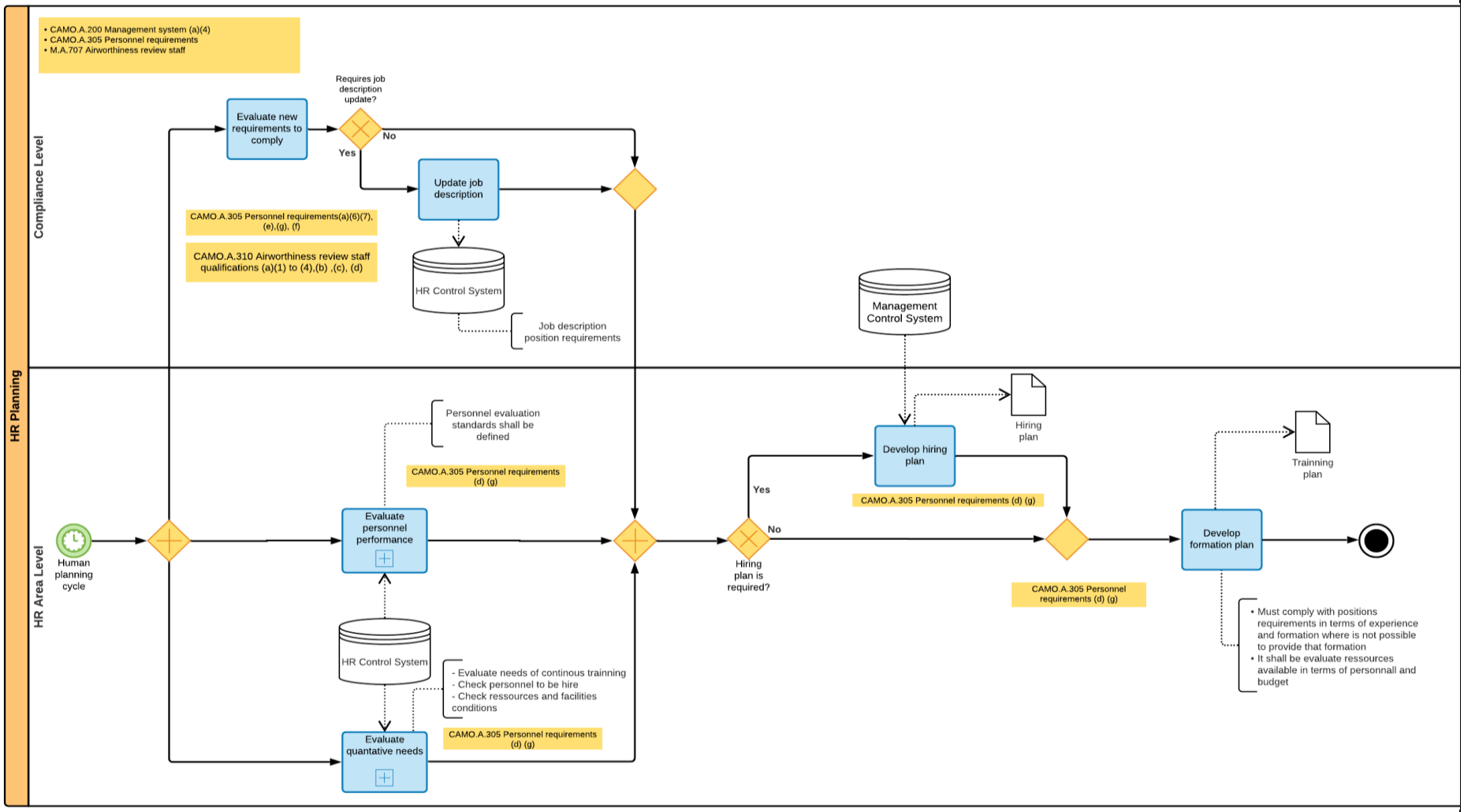


Figure 52 - BPMN Human Resources Planning Process

Process Level 1	6 - Human Resources Management
Process Level 2	6.2 - Human Resources Recruitment

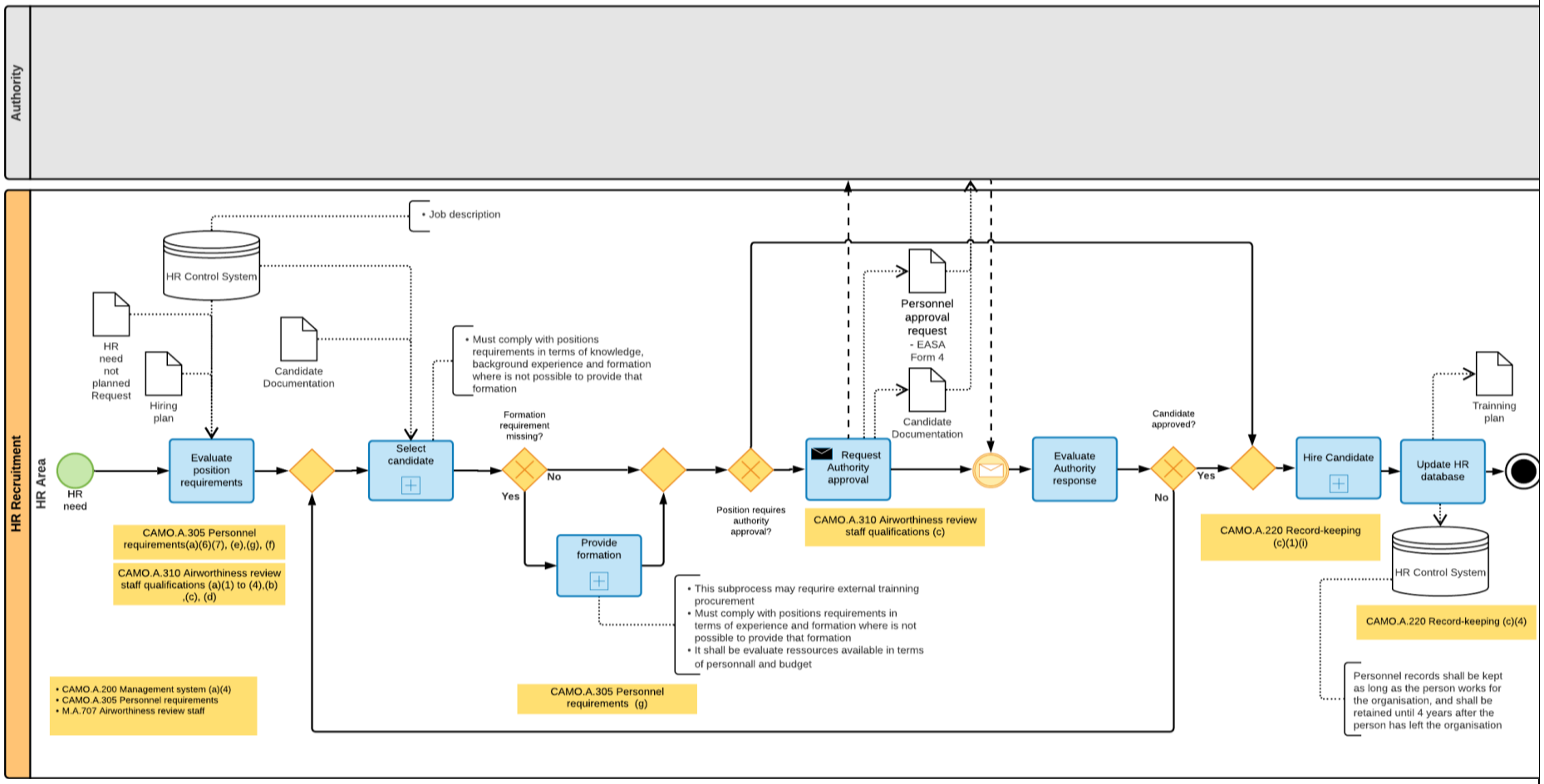


Figure 53 - BPMN Human Resources Recruitment Process

Process Level 1	6 - Human Resources Management
Process Level 2	6.3 - Human Resources Qualification Control

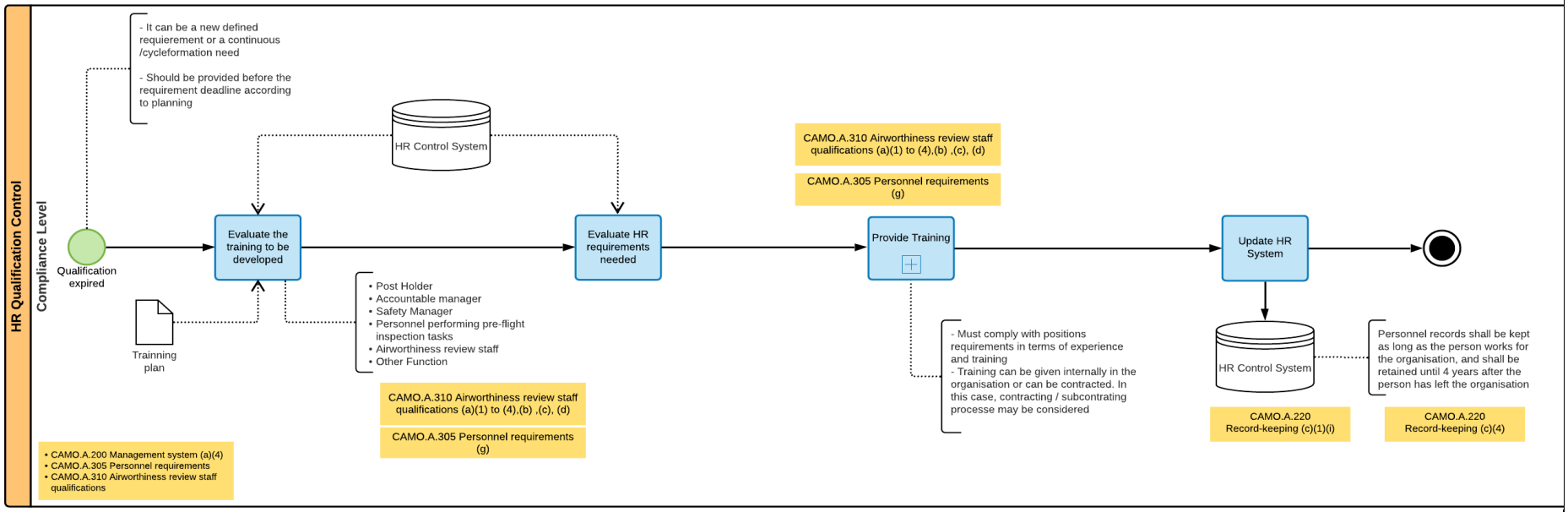


Figure 54 - BPMN Human Resources Qualification Control Process

Process Level 1	7 - Facility Management
Process Level 2	7.1 - Facility Planning and Control

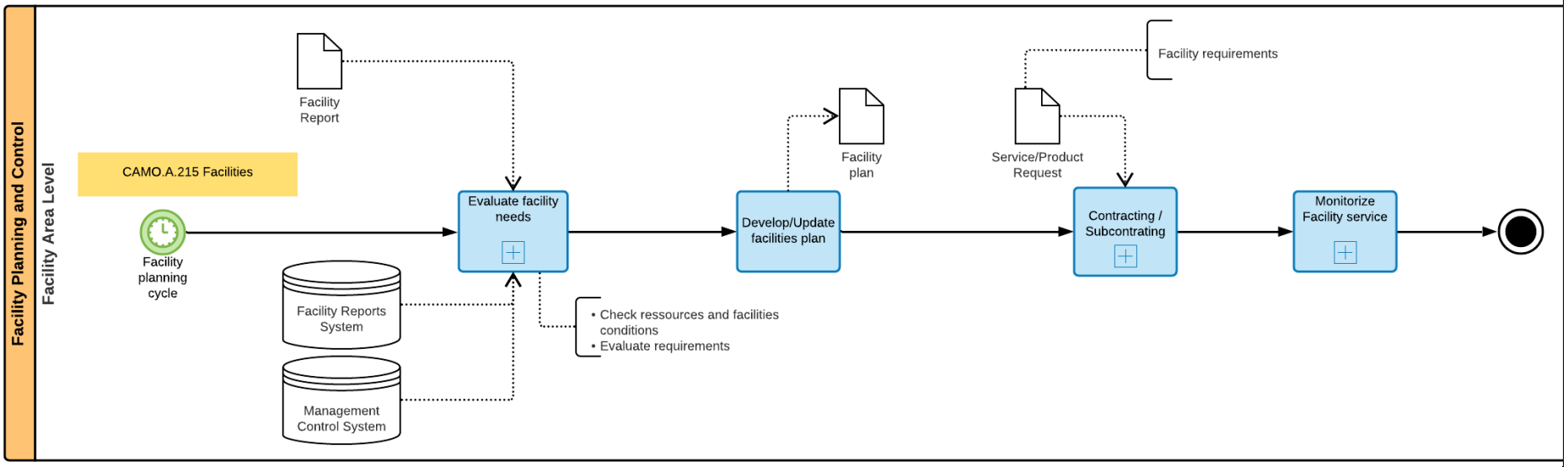


Figure 55 - BPMN Facility Planning and Control Process

Process Level 1	7 - Facility Management
Process Level 2	7.2 - Facility Report

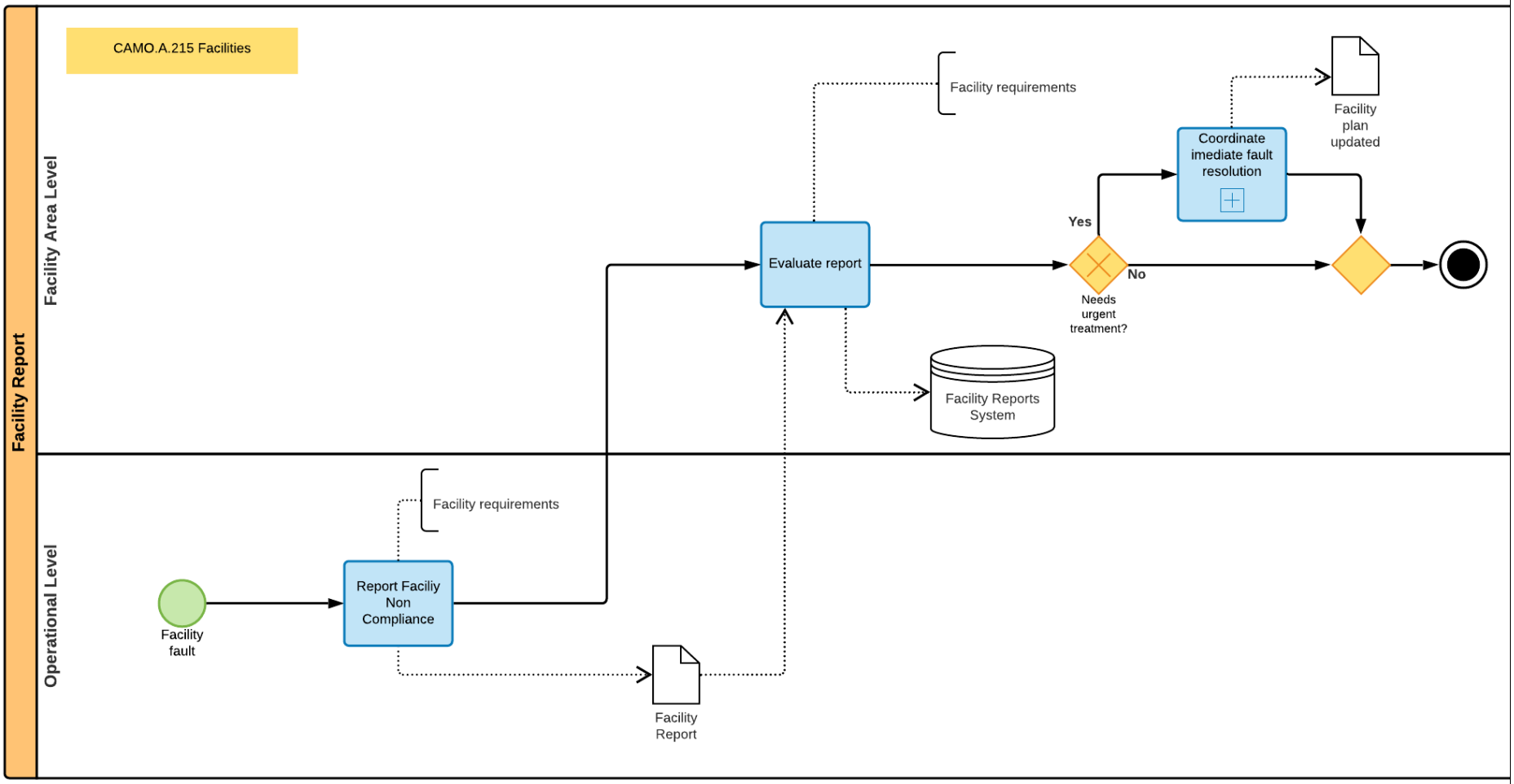


Figure 56 - BPMN Facility Report Process

Process Level 1	8 - Procurement Management
Process Level 2	8.1 - Contracting/Subcontracting

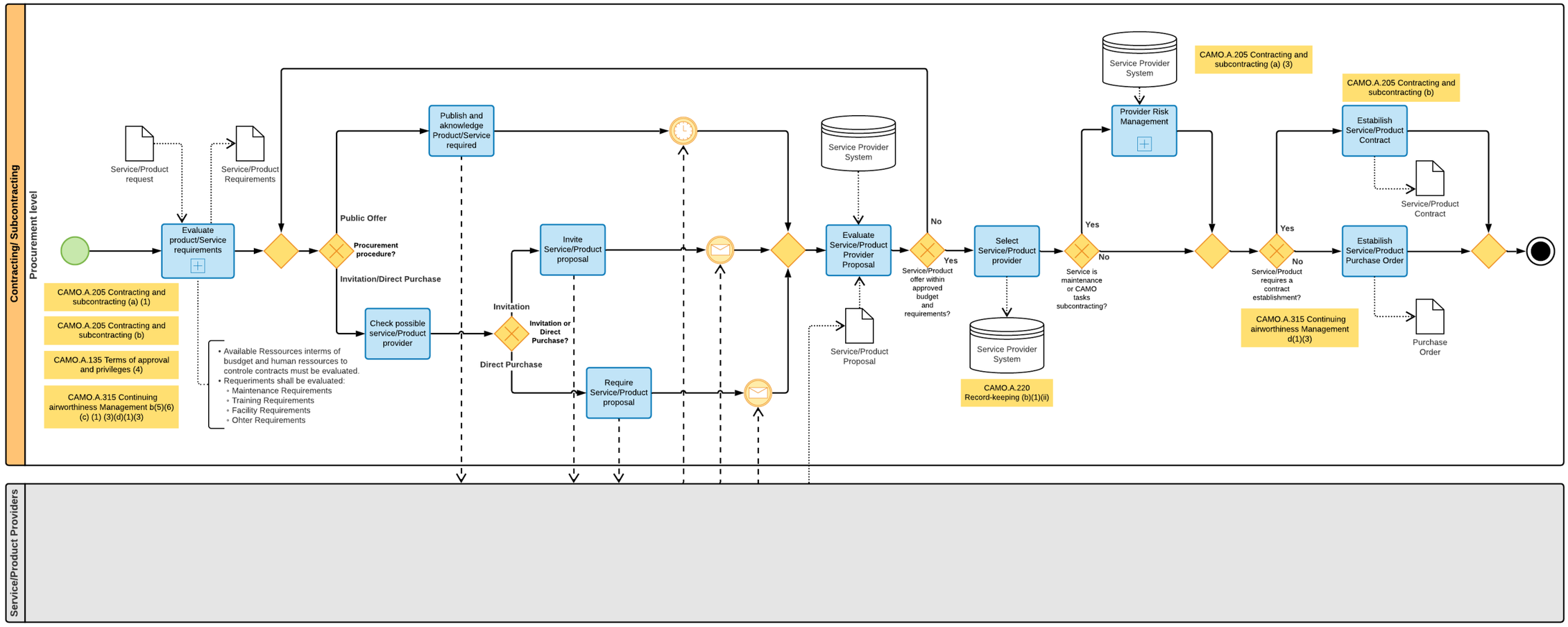


Figure 57 - BPMN Contracting/Subcontracting Process

Process Level 1	8 - Procurement Management
Process Level 2	8.2 - Provider Control

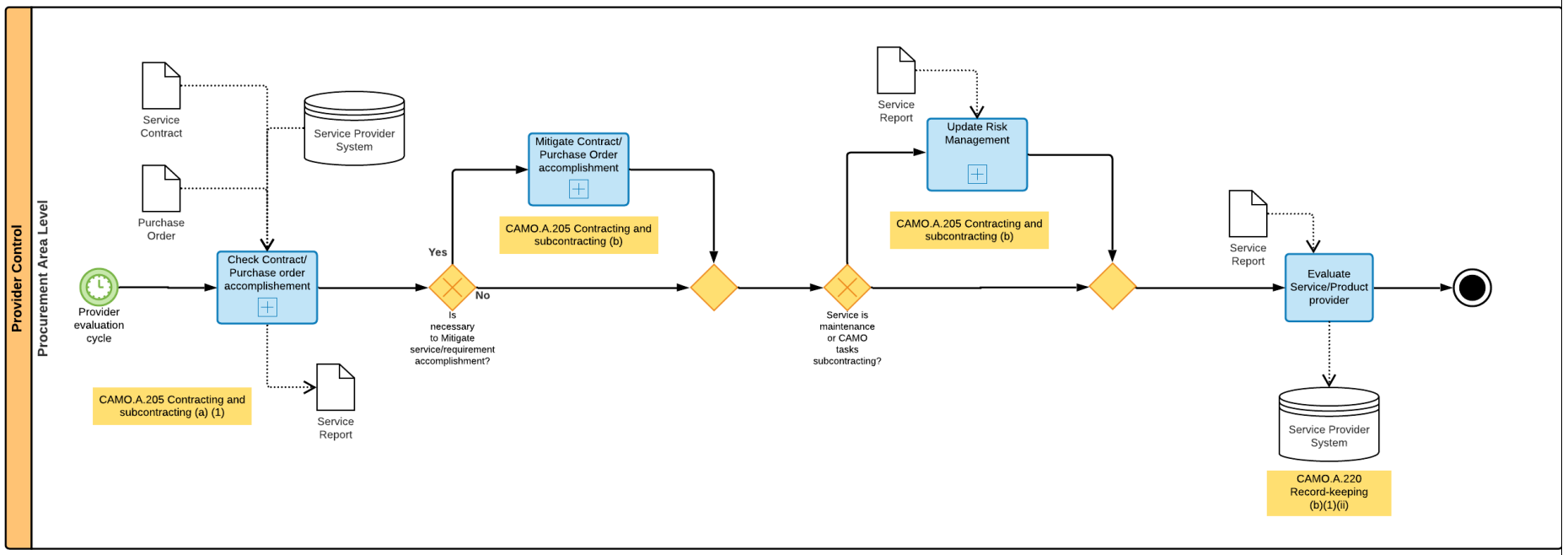


Figure 58 - BPMN Provider Control Process

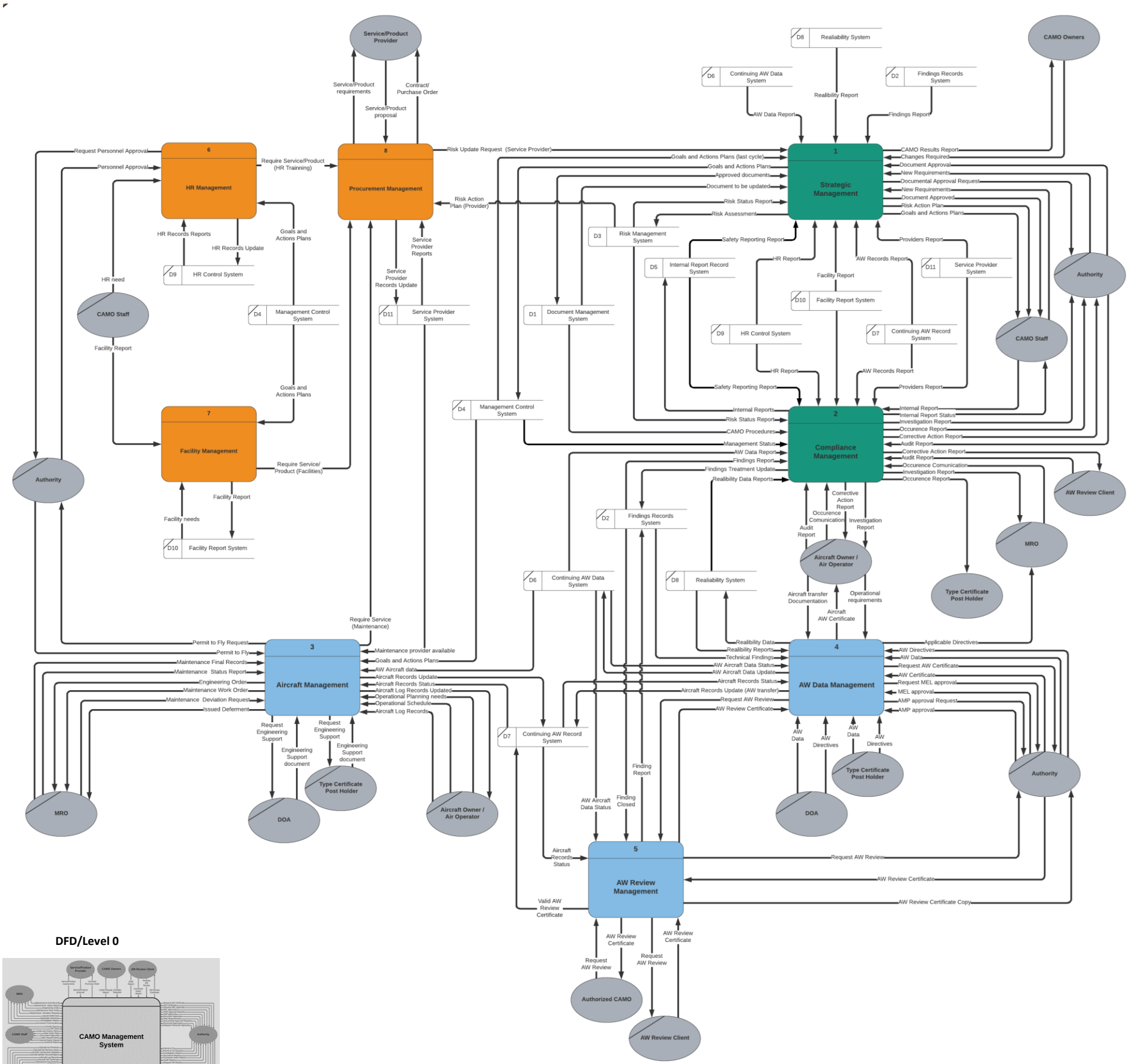
Processes Level 2	1-Document Management System	2-Finding Records System	3-Risk Management System	4-Management Control System	5-Internal Report Records System	6-Continuing AW Data System	7-Continuing AW Record System	8-Reliability System	9-HR Control System	10-Facility Reports System	11-Service Provider System	New Requirement	Verified Document	Developed/updated Document	Document Validated	Developed/updated Document	Document approved	Corrective Action Report	Risk Action plan	Changes Report	Assesment Report	Safety Report	Management cycle Report	CAMO Results Report	Action Plan	Objective Plan	Management System Policy	Goals Plan	CAMO Requirements	CAMO Documentation
1.1-Documental Management	X											X	X	X	X	X	X													
1.2-Risk Management	X	X	X		X	X	X	X	X	X	X								X											
1.3-System Monitoring	X	X		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X
2.1-Audit Management	X	X			X	X	X	X	X	X	X								X											
2.2-Findings Management		X			X													X												
2.3-Internal Reporting					X																									
2.4-Internal Investigation	X	X	X		X	X	X	X	X	X	X																			
2.5-Occurrence Reporting																														
3.1-Operation Control						X	X																							
3.2-Pre-Flight Inspection						X	X																							
3.3-Maintenance Control						X	X				X																			
3.4-Maintenance Planning				X		X	X																							
3.5-Permit to Fly Issuance						X	X																							
4.1-Data Management						X																								
4.2-Reliability Management		X				X	X	X																						
4.3-AMP Management						X	X																							
4.4-Directive Management						X																								
4.5-Configuration Management						X																								
4.6-Aircraft AW transfer							X																							
5.1-AW Review Evaluation							X																							
5.2-AW Review Issuance						X	X																							
6.1-HR Planning				X					X																					
6.2-HR Recruitment									X																					
6.3-HR Qualification Control									X																					
7.1-Facility Planning Control				X						X																				
7.2-Facility Report										X																				
8.1-Contracting/Subcontracting											X																			
8.2-Serv./Prod.provider control											X																			

Processes Level 2	Audit Plan	Audit Report	External Audit Report	Finding Report	Finding Treatment Request	Internal Investigation Request	Occurrence Request	Internal Investigation Request	Occurrence Request	Investigation Report	Occurrence Report	Follow Up Report Request	Operational Schedule	Aircraft technical log Records	Component technical log Records	Request to Permit To FLy	Maintenance Plan	Maintenance Work order	Maintenance Status Report	Enginenerring Order	Maintenance Final Records	Operational Planning Needs	Service Request	Permit to Fly (Form 20a/Form 20b)	New AW Data	Applicable AW Data
1.1-Documental Management																										
1.2-Risk Management																										
1.3-System Monitoring																										
2.1-Audit Management	X	X																								
2.2-Findings Management		X	X		X	X	X																			
2.3-Internal Reporting				X	X			X	X																	
2.4-Internal Investigation								X		X		X														
2.5-Occurrence Reporting											X	X														
3.1-Operation Control													X	X	X	X	X	X								
3.2-Pre-Flight Inspection														X										X		
3.3-Maintenance Control														X	X		X	X	X	X	X					
3.4-Maintenance Planning																	X	X				X				
3.5-Permit to Fly Issuance																X								X		
4.1-Data Management																									X	X
4.2-Reliability Management																										
4.3-AMP Management																										X
4.4-Directive Management																										
4.5-Configuration Management																										X
4.6-Aircraft AW transfer																										
5.1-AW Review Evaluation																										
5.2-AW Review Issuance																										
6.1-HR Planning																										
6.2-HR Recruitment																										
6.3-HR Qualification Control																										
7.1-Facility Planning Control																										
7.2-Facility Report																										
8.1-Contracting/Subcontracting																										
8.2-Serv./Prod.provider control																										

Processes Level 2	Realibility Program	Reliability Report	Operational Requirements	AMP Approved	New Issued Directive	Applicable Directive	MEL Approved	AW documentation	AW Certificate (Form 25)	Request for Airworthiness Review	Request AW Review Recom.	AW review certificate (Form 15a/Form 15b)	Request external AW review	Compliance Report	ARC Recomendation	Hiring Plan	Training Plan	HR need not planned Request	Candidate Documentation	Personnel approval request (Form 4)	Facility Plan	Facility Report	Service/Product Request	Service/Product Requirements	Service/Product Contract	Purchase Order	Service Report
1.1-Documental Management																											
1.2-Risk Management																											
1.3-System Monitoring																											
2.1-Audit Management																											
2.2-Findings Management																											
2.3-Internal Reporting																											
2.4-Internal Investigation																											
2.5-Occurrence Reporting																											
3.1-Operation Control																											
3.2-Pre-Flight Inspection																											
3.3-Maintenance Control																											
3.4-Maintenance Planning																							X				
3.5-Permit to Fly Issuance																											
4.1-Data Management																											
4.2-Reliability Management	X	X		X																							
4.3-AMP Management		X	X	X																							
4.4-Directive Management					X	X																					
4.5-Configuration Management							X																				
4.6-Aircraft AW transfer								X	X																		
5.1-AW Review Evaluation										X	X	X	X														
5.2-AW Review Issuance										X	X	X		X	X												
6.1-HR Planning																X	X										
6.2-HR Recruitment																	X	X	X	X							
6.3-HR Qualification Control																	X										
7.1-Facility Planning Control																					X	X	X				
7.2-Facility Report																						X					
8.1-Contracting/Subcontracting																							X	X	X	X	
8.2-Serv./Prod.provider control																											X

Figure 59 - Process vs Data objects matrix

Level 1 DFD	CAMO Information Architecture



DFD/Level 0

Figure 60 - CAMO Information Architecture level 1 DFD

Level 2 DFD	1 - Strategic Management

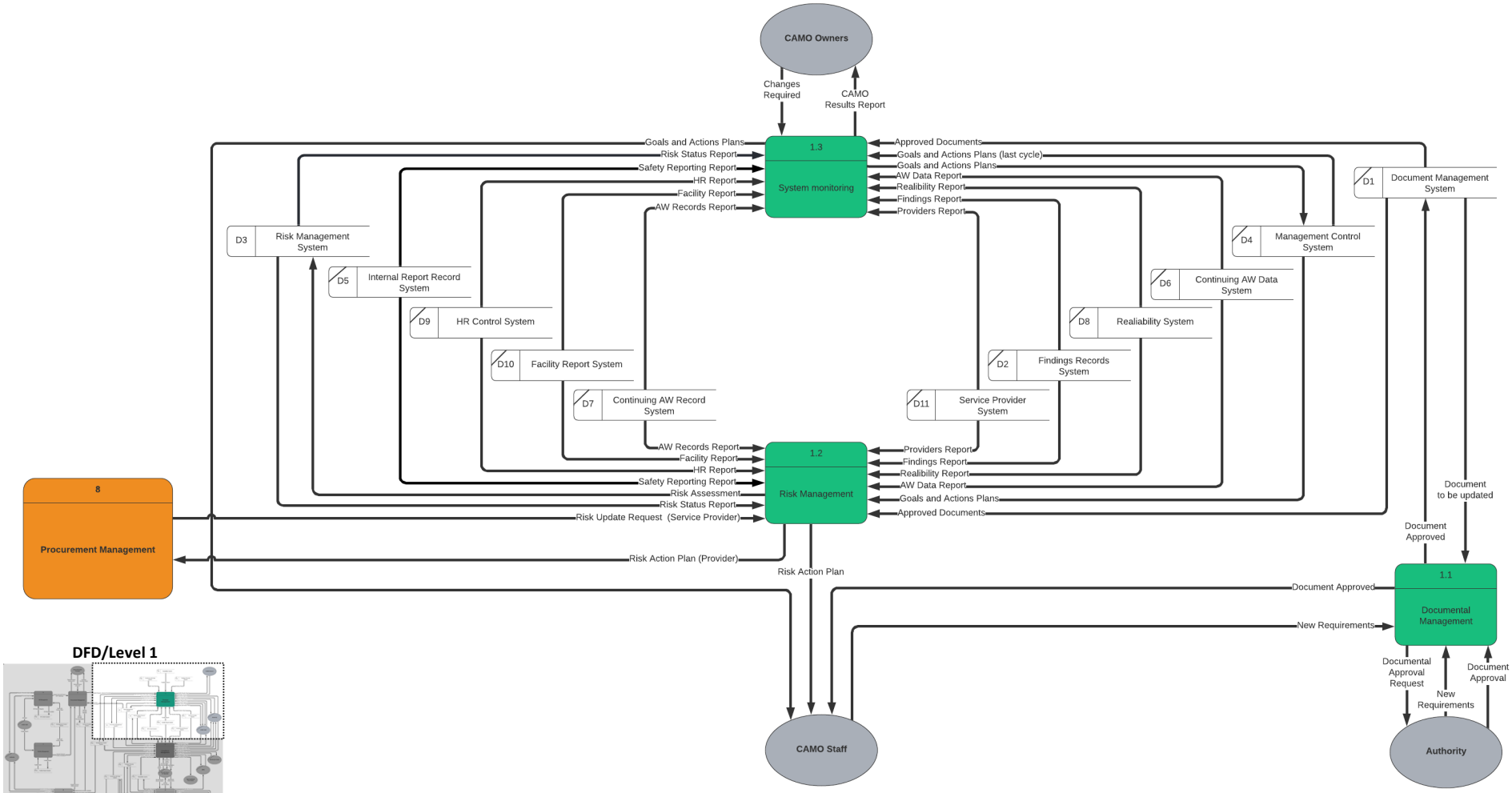
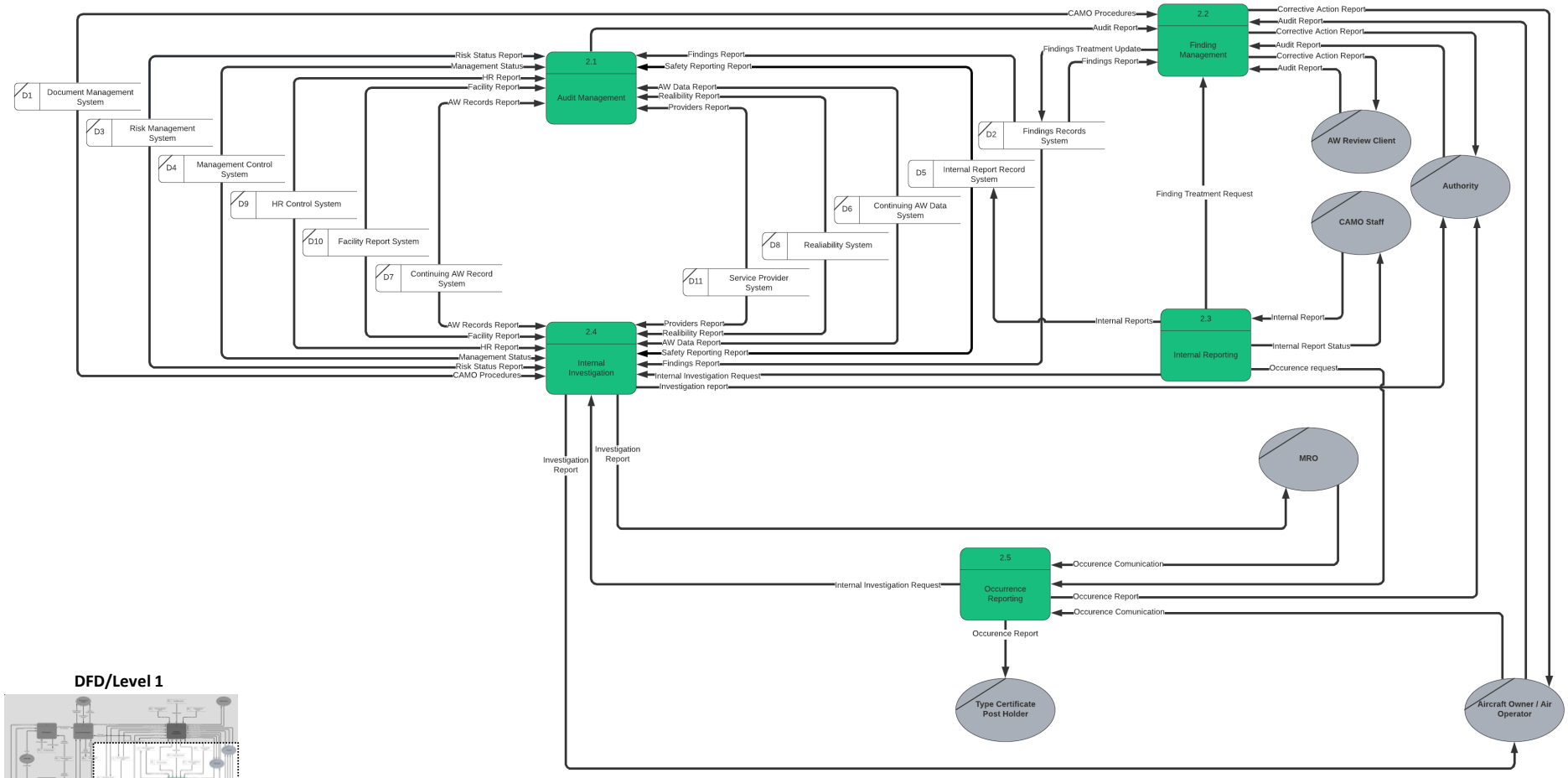


Figure 61 - Strategic Management level 2 DFD

Level 2 DFD	2 - Compliance Management



DFD/Level 1

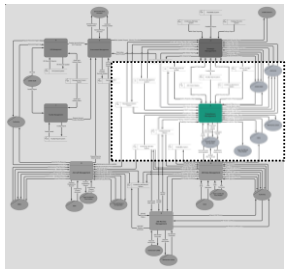
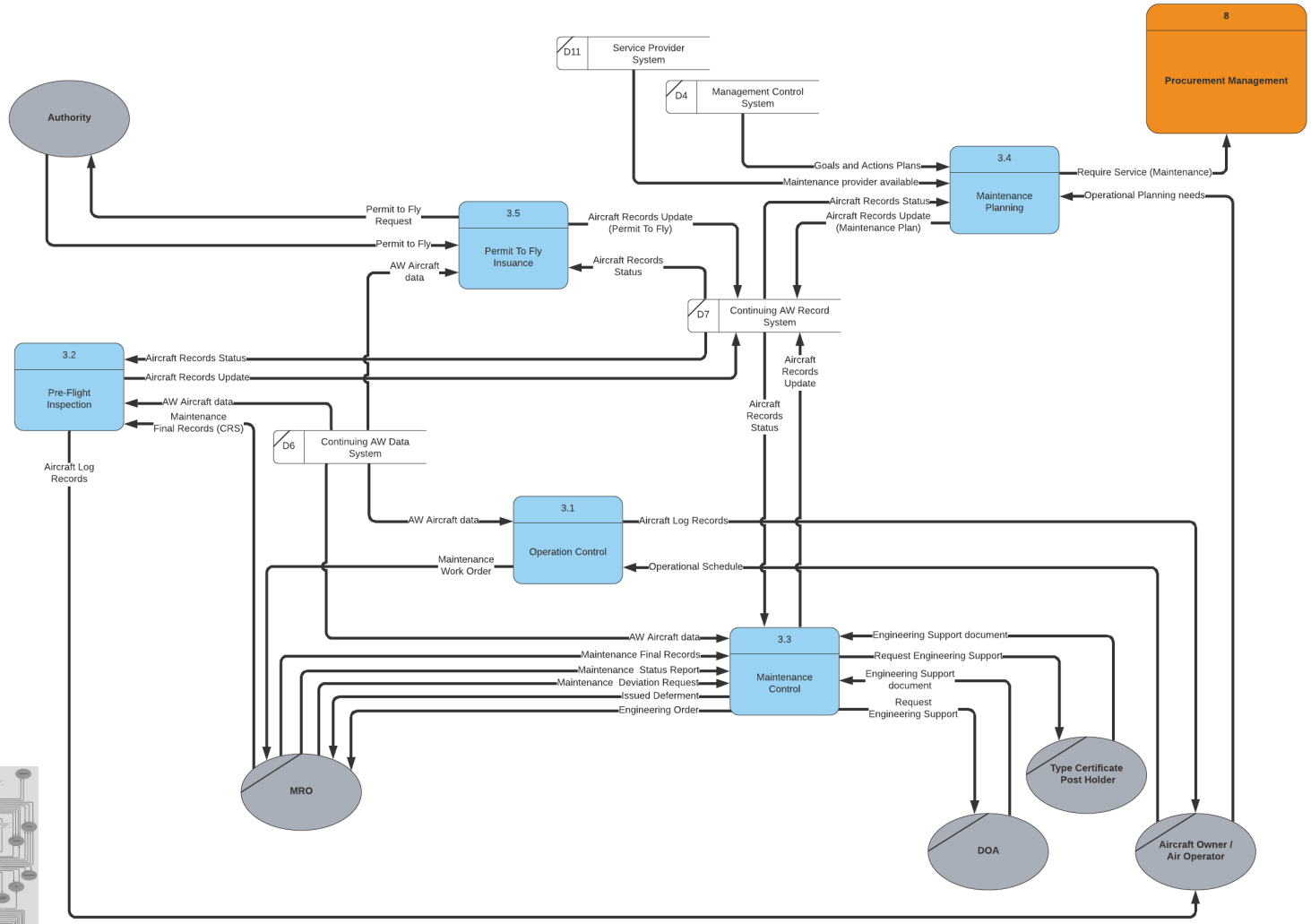


Figure 62 - Compliance Management level 2 DFD

Level 2 DFD	3 - Aircraft Management



DFD/Level 1

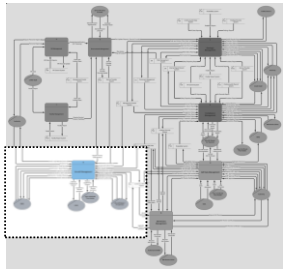
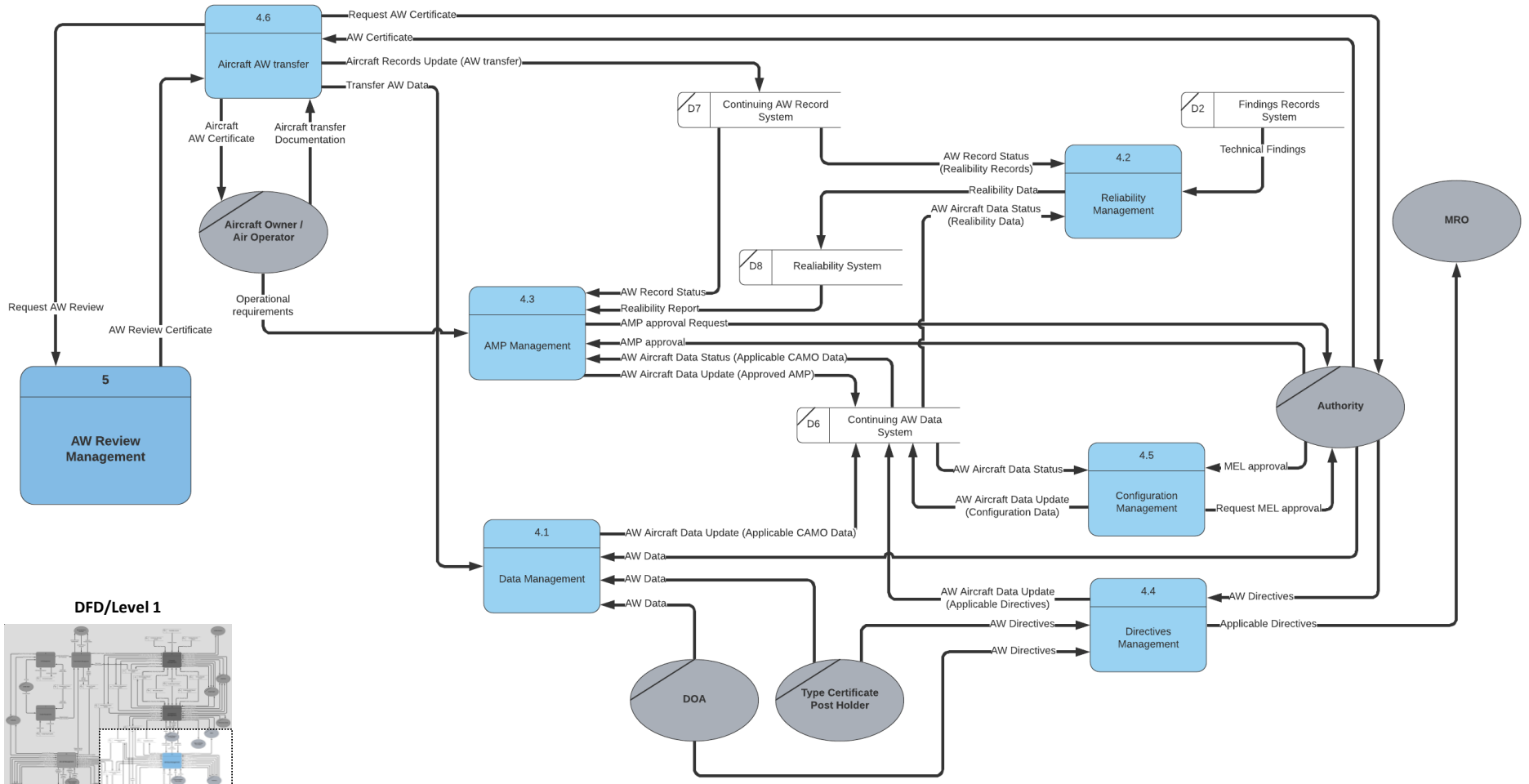


Figure 63 - Aircraft Management level 2 DFD

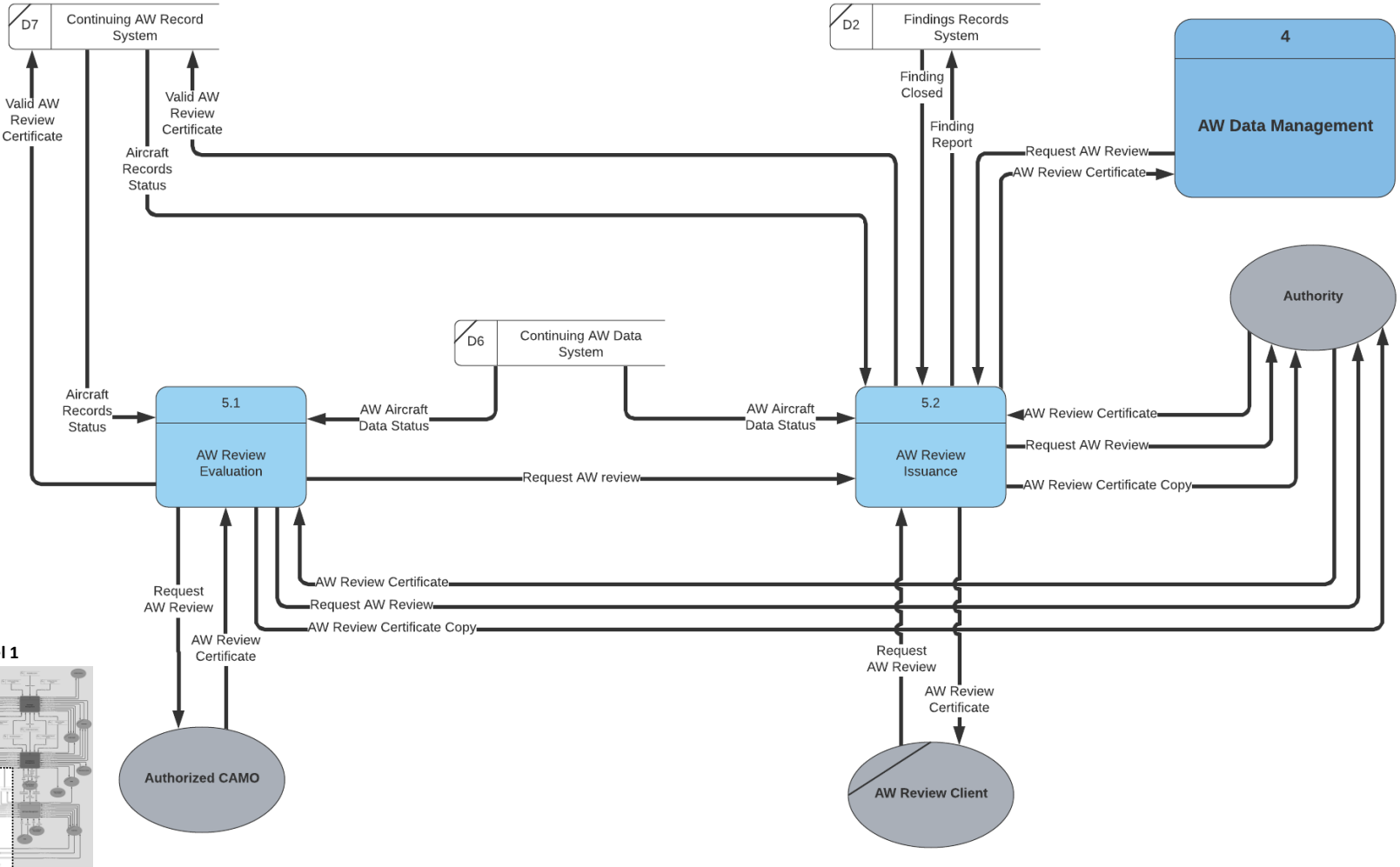
Level 2 DFD	4 - Airworthiness Data Management



DFD/Level 1

Figure 64 - Airworthiness Data Management level 2 DFD

Level 2 DFD	5 - Airworthiness Review Management



DFD/Level 1

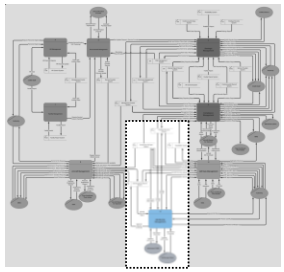
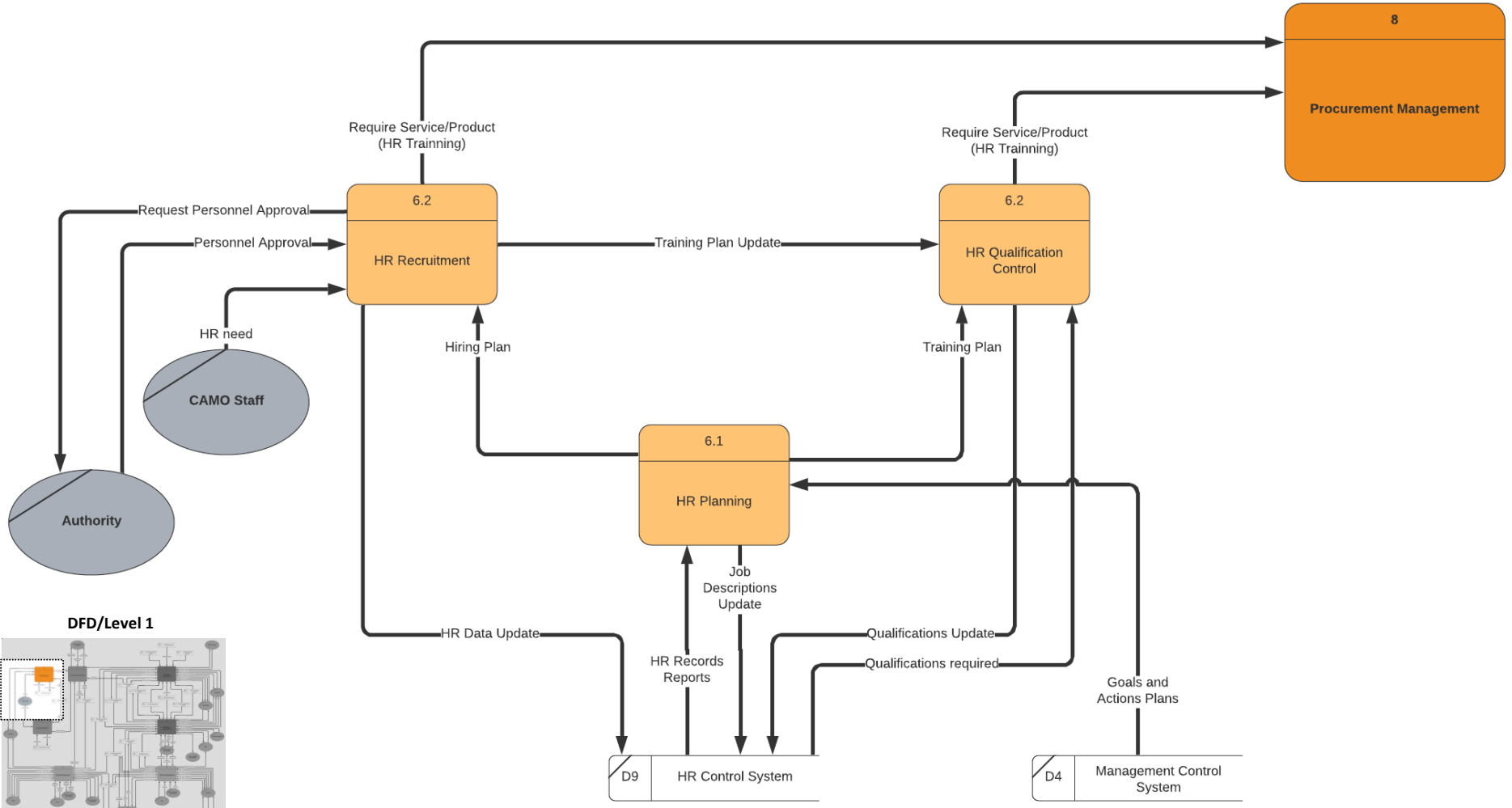


Figure 65 - Airworthiness Review Management level 2 DFD

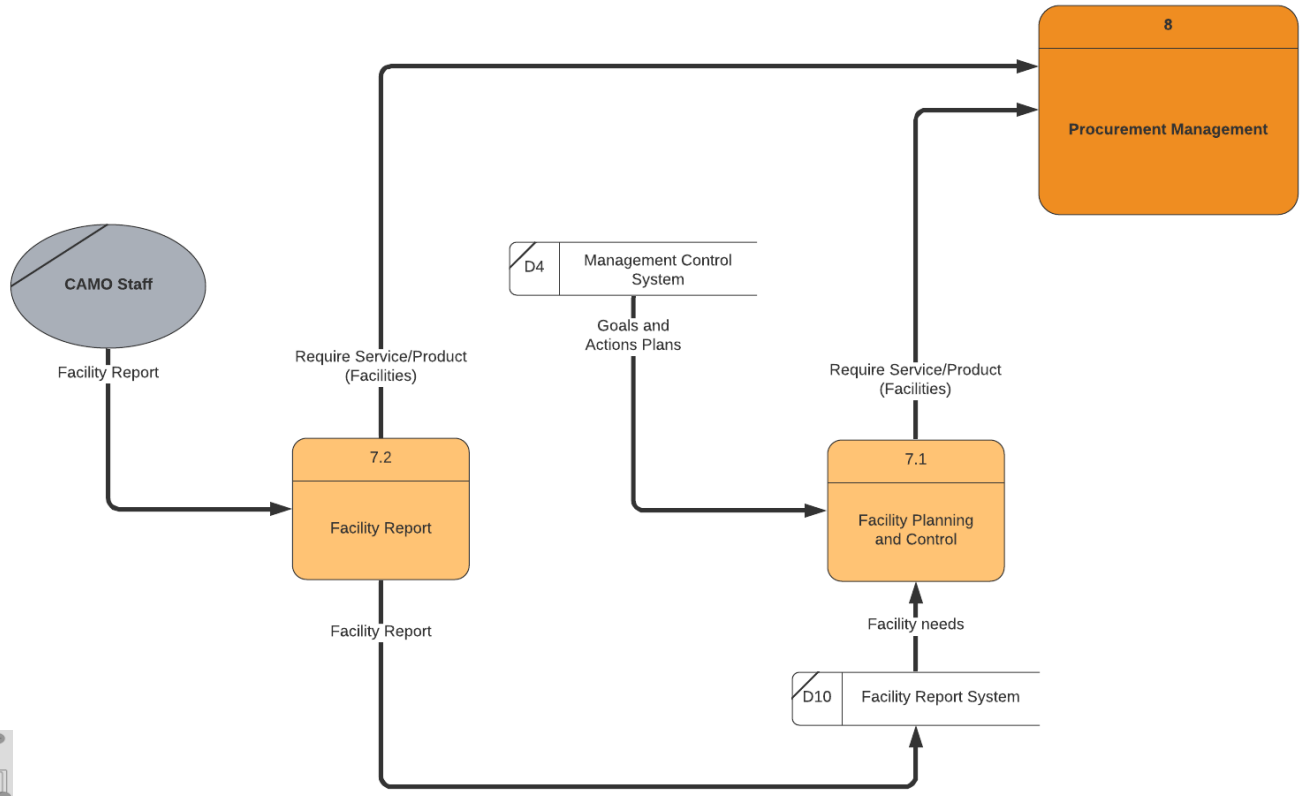
Level 2 DFD	6 - Human Resources Management



DFD/Level 1

Figure 66 - Human Resources Management level 2 DFD

Level 2 DFD	7 - Facility Management



DFD/Level 1

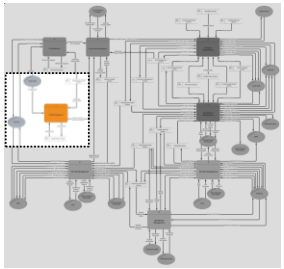


Figure 67 - Facility Management level 2 DFD

Level 2 DFD	8 - Procurement Management

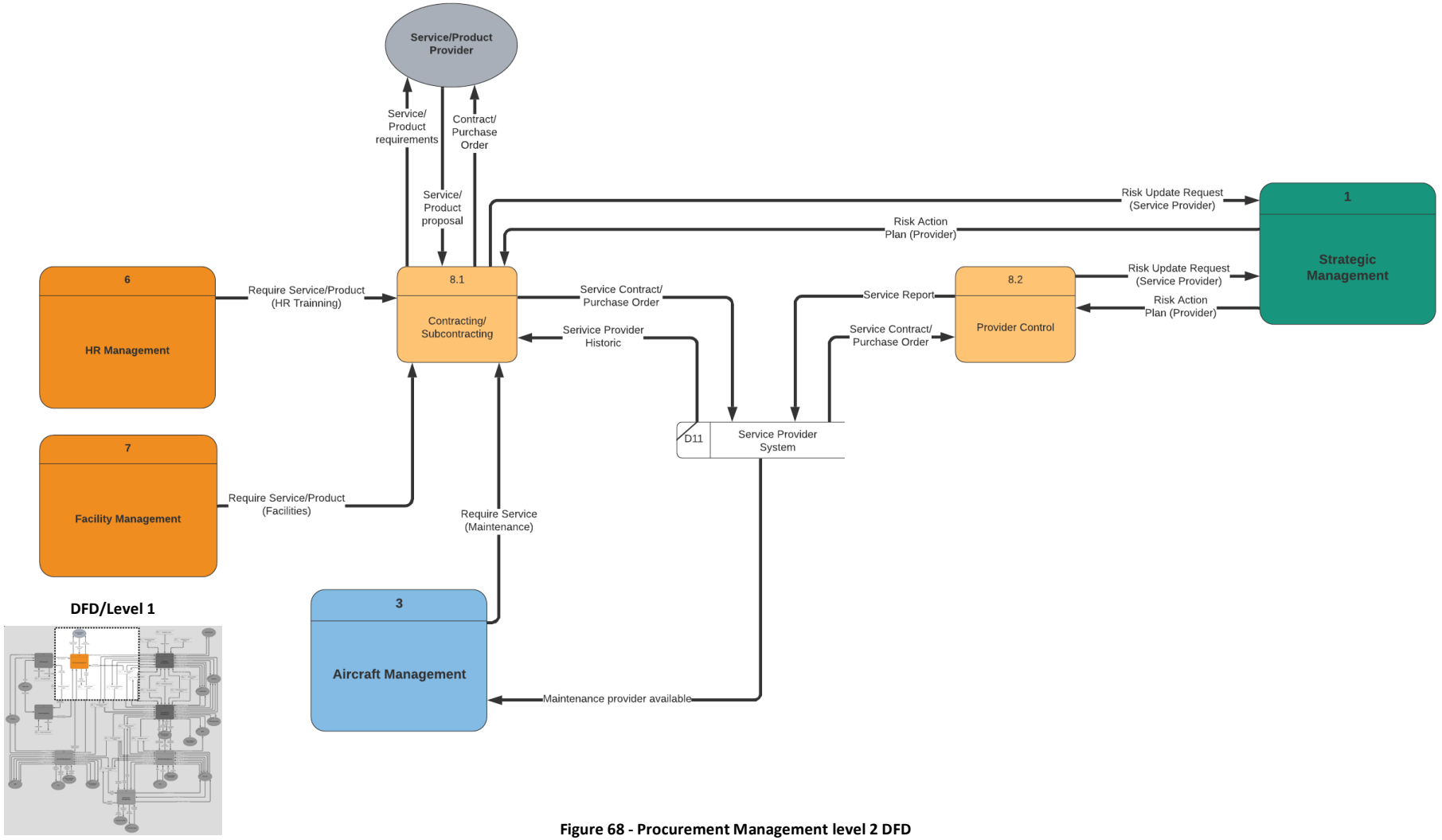


Figure 68 - Procurement Management level 2 DFD

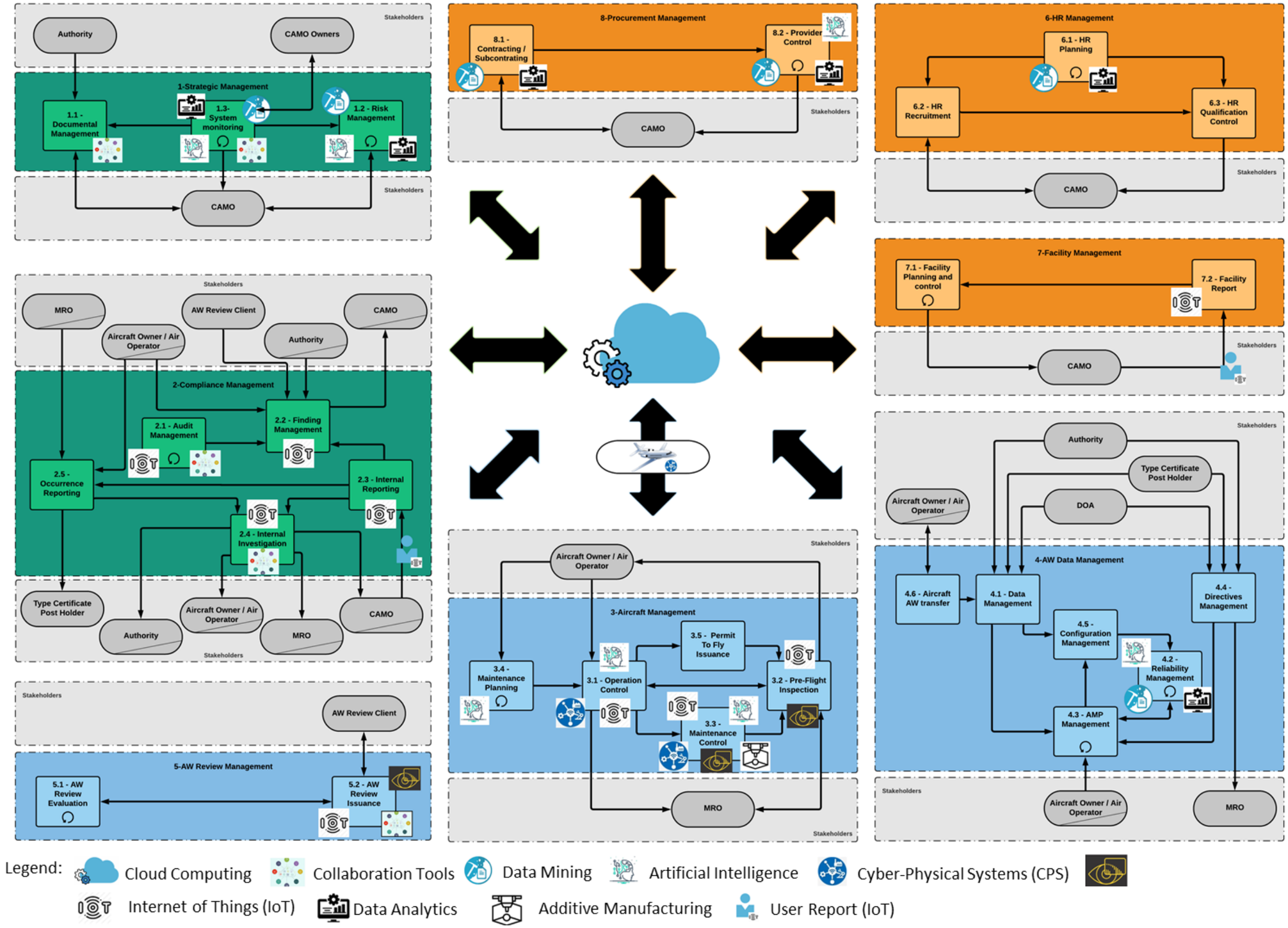


Figure 69 - Technological Architecture guidance scheme

ANNEXES

[COMPETENT AUTHORITY]

Details of Management Personnel required to be accepted as specified in Part-.....

1. Name:

2. Position:

3. Qualifications relevant to the item (2) position:

4. Work experience relevant to the item (2) position:

Signature: ..... Date: .....

On completion, please send this form under confidential cover to the competent authority

Competent authority use only
Name and signature of authorised competent authority staff member accepting this person:

Signature: ..... Date: .....

Name: ..... Office: .....

EASA Form 4

Figure 70 - EASA Form 4 (EASA 2021b)

[MEMBER STATE]
A Member of the European Union (*)

AIRWORTHINESS REVIEW CERTIFICATE (ARC)

ARC reference: .....

Pursuant to Regulation (EU) 2018/1139 of the European Parliament and of the Council the [COMPETENT AUTHORITY OF THE MEMBER STATE] hereby certifies that the following aircraft:

Aircraft manufacturer: .....
Manufacturer's designation: .....
Aircraft registration: .....
Aircraft serial number: .....
is considered airworthy at the time of the review.

Date of issue: ..... Date of expiry: .....
Airframe Flight Hours (FH) at date of issue (**): .....
Signed: ..... Authorisation No: .....

1st extension: The aircraft has remained in a controlled environment in accordance with point M.A.901 of Annex I (Part-M) to Commission Regulation (EU) No 1321/2014 for the last year. The aircraft is considered to be airworthy at the time of the issue.
Date of issue: ..... Date of expiry: .....
Airframe Flight Hours (FH) at date of issue (**): .....
Signed: ..... Authorisation No: .....
Company Name: ..... Approval reference: .....

2nd extension: The aircraft has remained in a controlled environment in accordance with point M.A.901 of Annex I (Part-M) to Commission Regulation (EU) No 1321/2014 for the last year. The aircraft is considered to be airworthy at the time of the issue.
Date of issue: ..... Date of expiry: .....
Airframe Flight Hours (FH) at date of issue (**): .....
Signed: ..... Authorisation No: .....
Company Name: ..... Approval reference: .....

EASA Form 15a Issue 5

(*) Delete for non-EU Member States.

(**) Except for balloons and airships.

Figure 71 - EASA Form 15a (EASA 2021b)

[MEMBER STATE]
A Member of the European Union (*)

AIRWORTHINESS REVIEW CERTIFICATE (ARC)

ARC reference: .....

Pursuant to Regulation (EU) 2018/1139 of the European Parliament and of the Council the following organisation, approved in accordance with Section A of Annex Vc (Part-CAMO) or Section A of Subpart G of Annex I (Part-M) or Section A of Annex Vb (Part-CAO) to Commission Regulation (EU) No 1321/2014,

[NAME OF ORGANISATION APPROVED AND ADDRESS]

[APPROVAL REFERENCE]

hereby certifies that it has performed an airworthiness review in accordance with point M.A.901 of Annex I to Commission Regulation (EU) No 1321/2014 on the following aircraft:

Aircraft manufacturer: .....
Manufacturer's designation: .....
Aircraft registration: .....
Aircraft serial number: .....
and this aircraft is considered airworthy at the time of the review.

Date of issue: ..... Date of expiry: .....
Airframe Flight Hours (FH) at date of issue (**): .....
Signed: ..... Authorisation No: .....

1st extension: The aircraft has remained in a controlled environment in accordance with point M.A.901 of Annex I (Part-M) to Commission Regulation (EU) No 1321/2014 for the last year. The aircraft is considered to be airworthy at the time of the issue.
Date of issue: ..... Date of expiry: .....
Airframe Flight Hours (FH) at date of issue (**): .....
Signed: ..... Authorisation No: .....
Company Name: ..... Approval reference: .....

2nd extension: The aircraft has remained in a controlled environment in accordance with point M.A.901 of Annex I (Part-M) to Commission Regulation (EU) No 1321/2014 for the last year. The aircraft is considered to be airworthy at the time of the issue.
Date of issue: ..... Date of expiry: .....
Airframe Flight Hours (FH) at date of issue (**): .....
Signed: ..... Authorisation No: .....
Company Name: ..... Approval reference: .....
* Delete for non-EU Member States

EASA Form 15b Issue 6

(*) Delete for non-EU Member States.

(**) Except for airships.

Figure 72 - EASA Form 15b (EASA 2021b)

Competent authority logo	**PERMIT TO FLY**

[1]	
This permit to fly is issued pursuant to Regulation (EC) No 216/2008, Article 5(4)(a) and certifies that the aircraft is capable of safe flight for the purpose and within the conditions listed below and is valid in all Member States This permit is also valid for flight to and within non-Member States provided separate approval is obtained from the competent authorities of such States:	1. Nationality and registration marks:
2. Aircraft manufacturer/type:	3. Serial No:
4. The permit covers: [purpose in accordance with 21.A.701(a)]	
5. Holder: [in case of a permit to fly issued for the purpose of 21.A.701(a)(15) this should state: 'the registered owner']	
6. Conditions/remarks:	
7. Validity period:	
8. Place and date of issue:	9. Signature of the competent authority representative:

EASA Form 20a

Figure 73 - EASA Form 20a (EASA 2021a)

Member State of the Competent Authority having issued the organisation approval under which the permit to fly is issued; or 'EASA' when approval issued by EASA

PERMIT TO FLY

Name and Address of the organisation issuing the permit to fly	[1]
This permit to fly is issued pursuant to Regulation (EC) No 216/2008, Article 5(4)(a) and certifies that the aircraft is capable of safe flight for the purpose and within the conditions listed below and is valid in all Member States This permit is also valid for flight to and within non-Member States provided separate approval is obtained from the competent authorities of such States.	1. Nationality and registration marks:
2. Aircraft manufacturer/type:	3. Serial No:
4. The permit covers: [purpose in accordance with 21.A.701(a)	
5. Holder: *[Organisation issuing the permit to fly]*	
6. Conditions/remarks:	
7. Validity period:	
8. Place and date of issue:	9. Authorised signature: Name: Approval Reference No:

EASA Form 20b

Figure 74 - EASA Form 20b (EASA 2021a)

CERTIFICATE OF AIRWORTHINESS

[1]	[Member State of registry] [COMPETENT AUTHORITY OF THE MEMBER STATE]	[1]
1. Nationality and registration marks	2. Manufacturer and manufacturer's designation of aircraft	3. Aircraft serial number
4. Categories		
5. This Certificate of Airworthiness is issued pursuant to the Convention on International Civil Aviation dated 7 December 1944 and Regulation (EC) No 216/2008, Article 5(2)(c) in respect of the abovementioned aircraft which is considered to be airworthy when maintained and operated in accordance with the foregoing and the pertinent operating limitations. Limitations/Remark: [1] Date of issue: Signature:		
6. This Certificate of Airworthiness is valid unless revoked by the competent authority of the Member State of registry. A current Airworthiness Review Certificate shall be attached to this certificate.		

EASA Form 25 Issue 2.

Figure 75 - EASA Form 25 (EASA 2021a)