Comparative Analysis of Aircraft Modification Processes: EASA, FAA, and DGCA Indonesia

Nurfrida Nashira Ramadhanti*[1,2], Hisar Manongam Pasaribu[1]

[1]Faculty of Mechanical and Aerospace Engineering - Institut Teknologi Bandung
ITB Kampus Ganesha Jl. Ganesha 10, Jawa Barat, Bandung, 40132, Indonesia
[2]International Air Transport Operations Management - Ecole Nationale de l'Aviation Civile
7, Avenue Edouard Belin, Haute-Garonne, Toulouse, 31400, France

E-mail: *nurfrida.ramadhanti@gmail.com

Diterima: 18 Januari 2023, disetujui: 27 November 2023, diterbitkan online: 29 Desember 2023

Abstract

This study conducts a comparative analysis of aircraft modification certification processes within the aviation regulatory frameworks of the Federal Aviation Administration (FAA), the European Union Aviation Safety Agency (EASA), and the Directorate General of Civil Aviation (DGCA) in Indonesia. Using the TCAS 7.1 Software Updates modification on the A320-200 as a case study, the research explores Design Organization Approval (DOA) or Organization Designation Authorization (ODA) procedures. The findings reveal variations in Design Organization structures and certification processes, offering valuable insights into Indonesia's emerging aviation market. By adapting best practices from the FAA and EASA, the study aimed to contribute to the enhancement of Indonesia's regulatory system, benefiting policymakers, regulators, and industry stakeholders.

Keywords: Airworthiness, Aircraft Modification, TC Change, EASA, FAA, DGCA Indonesia

Abstrak

Analisis Perbandingan Proses Modifikasi Pesawat: EASA, FAA, dan DGCA Indonesia: *Penelitian ini melakukan analisis perbandingan proses sertifikasi modifikasi pesawat dalam kerangka regulasi penerbangan Federal Aviation Administration (FAA), European Union Aviation Safety Agency (EASA), dan Direktorat Jenderal Perhubungan Udara (DGCA) di Indonesia. Dengan menggunakan pembaruan perangkat lunak TCAS 7.1 pada A320-200 sebagai studi kasus, penelitian ini mengeksplorasi prosedur Design Organization Approval (DOA) atau Organization Designation Authorization (ODA). Temuan menunjukkan variasi dalam struktur Organisasi Desain dan proses sertifikasi, memberikan wawasan berharga untuk pasar penerbangan yang berkembang di Indonesia. Dengan mengadaptasi praktik terbaik dari FAA dan EASA, penelitian ini bertujuan untuk berkontribusi pada peningkatan sistem regulasi Indonesia, memberikan manfaat bagi pembuat kebijakan, regulator, dan pemangku kepentingan industri.*

Kata kunci: Keselamatan Udara, Modifikasi Pesawat, Perubahan TC, EASA, FAA, DGCA Indonesia

1. Introduction

The dynamic nature of the aviation industry necessitates ongoing adaptation and alignment of regulatory frameworks across diverse regions. Discrepancies in national regulations can present substantial challenges for Design Organizations engaged in international operations, especially in the realm of aircraft modification procedures.

Yang and Liu conducted a study to compare the Airworthiness Management status of Civil Aircraft Design Organizations in Europe and the US. Their objective was to offer guidance and assistance for airworthiness work and research by civil aircraft design organizations in China. The study identified the four essential elements of the Design Assurance System (DAS) in EASA Design Organisation Approval (DOA) and the Basic Model of FAA TC Organization Designation Authorization (ODA). Furthermore, Yang and Liu described the various types of FAA approvals and analyzed the extent of EASA DOA [1].

Tao et al. propose a comparison of the Design Assurance System between EASA and the Civil Aviation Administration of China (CAAC) while considering the uniformity of airworthiness certification systems between CAAC and the Federal Aviation Administration (FAA), and the initial origin of DAS. Unlike Yang and Liu, Tao et al identified three core functions of DAS and the objective of the study is to propose airworthiness resources for Aircraft Manufacturer Organizations in China [2].

Winkeler et al. carried out a study comparing the FAA Design Organization with EASA and ANAC COPj Brazil. As ANAC COPj follows the EASA approach for certification, the focus was on the comparison between the FAA and EASA. Referred to 14 CFR Part 21, this study described design approval processes for both entirely new aircraft designs requiring a type certificate (TC) issuance and modifications to approved designs, which can take the form of an amendment to the TC (ATC) or a

doi: http://dx.doi.org/10.25104/warlit.v35i2.2314
0852-1824/ 2580-1082
Nomor akreditasi: (RISTEKDIKTI) 10/E/KPT/2019 (Sinta 2).

supplemental TC (STC). This study used the Boeing 737 MAX certification process as a case study and analyzed possible failures that occurred during the process. It also provided insights into optimizing and improving the ODA program while evaluating proposed changes [3].

While previous studies have compared the regulatory approaches of the Federal Aviation Administration (FAA) and the European Union Aviation Safety Agency (EASA) with those of other aviation authorities, such as China [1]-[2], and Brazil [3], a comprehensive analysis focusing on the Indonesian Directorate General of Civil Aviation (DGCA) regulations remains a critical gap in the existing research landscape. Despite its importance, the DGCA's regulatory approach has not been extensively studied and compared to FAA and EASA.

This paper aims to reveal both significant similarities and key distinctions in the regulations set forth by these countries and their approaches to regulating the Design Organization and Certification Procedure for Aircraft Modification. Additionally, the aim is to assist related stakeholders in adopting procedures that align with those established by the FAA and EASA, particularly when conducting aircraft modification in the US and Europe, respectively [4]. Similarly, it applies vice versa for organizations from the US and Europe seeking to establish themselves in Indonesia. To facilitate the comparative study, TCAS 7.1 Upgrade Modification on A320-200 is used as the case study for the aircraft modification process.

2. Methodology

The methodology employed in this study can be described as follows. The development of problem statements involves formulating clear and concise problem statements that address the challenges and gaps identified in the design organization approval and certification process. Then, the research objectives are established to guide the study and provide a clear direction for the research. These objectives define the specific outcomes that the research aims to achieve.

To gain a comprehensive understanding of the procedures, regulations, and standards for each civil aviation authority: FAA, EASA, DGCA Indonesia, an extensive literature review was conducted. The literature review encompassed regulations, and guidance documents such as Staff Instructions, Orders or Advisory Circulars. Previous studies on airworthiness management, design assurance systems, and comparative analyses of the FAA, EASA, and other countries were also thoroughly examined to identify potential gaps in the existing body of knowledge.

In analysis and discussion, a comparative study is conducted to identify and emphasize the similarities and differences in the design organization and/or representatives of the administrator, certification processes and regulatory requirements of the three civil aviation authorities with the study case of TCAS 7.1 Software Upgrade. The comparative analysis commences with defining the subjects or objects to be compared, followed by the selection of suitable comparison criteria and an appropriate comparison method. Subsequently, a comparison table is constructed to illustrate the findings. To highlight the analysis, an alternating (point-by-point) method is employed, identifying similarities or differences between each subject and alternating between them in the writing [5]. Upon completion of the analysis and discussion, this final section provides a summary of the research findings, discusses their implications, and draws conclusions.

3. Discussion and Analysis

3.1. Design Organization and/or Representatives of the Administrator

3.1.1. Definition, Type and Scope of Work

Design Organization Approval (DOA) in the EASA regulatory framework means the recognition by EASA that a Design Organization has the demonstrated capacity and capability to design, validate the design to show compliance with applicable requirements and to perform airworthiness and certification activities on behalf of EASA under granted privileges [6]. In the FAA regulatory framework, Organization Designation Authorization (ODA) means the authorization to perform approved functions on behalf of the Administrator [7].

FAA has two programs under 14 CFR Part 183 that allow individuals and organizations to perform certain aircraft certification tasks: Individual Representative and Organization Designation Authorization

(ODA). These programs are classified based on the specific qualifications and functions of the individuals or organizations involved [8].

EASA only allows organizations with Design Organisation Approval (DOA) under EASA Part 21 Subpart J to perform aircraft certification tasks. The scope of work and the products, changes or repairs with the appropriate limitations are defined in the Terms of Approval. However, there is no equivalent program for individual representatives in the EASA system [9].

DGCA Indonesia has combined elements of both the FAA and EASA systems, enabling individuals and organizations to perform certain certification tasks. It has adopted the FAA Individual Representatives Program, but with some different types of designations as outlined in CASR Part 183 [9]. For organizations, the DGCA has adopted the EASA DOA Program [10]. Nevertheless, it has created a concise classification system with four classes of DOAs based on the design and compliance scope as illustrated in Figure 1. This is governed under CASR Part 21.

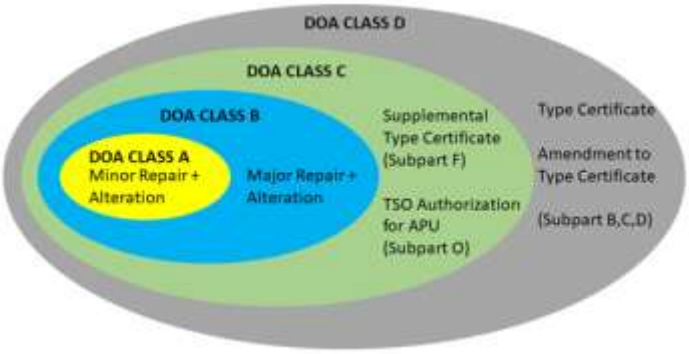

Figure 1. DOA Classification based on CASR 21.236

The specifics of the certification product scope undertaken by the design organization, along with the categorization of design organizations as defined by respective regulators, are elucidated in Table 1. This comprehensive table serves as a valuable reference, offering insights into the distinct parameters and criteria established by each regulator for the various types of design organizations.

Following the criteria outlined in Table 1, the design organization applying for certification for the type design change of TCAS 7.1 Upgrade Modification is required to hold the approvals specified in Table 2.

3.1.2. DOA or DOA Certification Procedure

The FAA, EASA, and DGCA each have established procedures for the certification of ODAs or DOAs. The FAA outlines its procedure in Order 8100.15B Change 3 [11], EASA details its procedure in the DOA Initial Investigation Information Paper [12], and DGCA Indonesia defines its procedure in SI 21-10 [13]. The following Table 3 summarizes the procedures outlined by these three authorities.

3.1.3. Design Assurance System

The purpose of DAS is to guarantee the ongoing compliance of product, parts, and appliance designs and changes with applicable certification specifications and environmental protection requirements. It also aims to ensure that responsibilities are appropriately fulfilled under DOA provisions and approval terms. Additionally, DAS is established to facilitate an independent monitoring function, overseeing any changes in organizational structure, individual responsibilities, procedures, and resources [1]. Table 4 illustrates a comparison of the Design Assurance Systems in FAA, EASA, and DGCA [6][11][13].

Table 1. DOA or ODA Type Comparison

No.	Certificate Product Type	Organization Type / Scope of Work / Class		
		FAA	EASA	DGCA
1		Type Certificate		
	Major Change to TC by TC Holder (Amendment to TC)	TC ODA	TC DOA (under privileges 1, 2, 5, 6, 7, 8, 9)	DOA Class D
	Minor Change to TC by TC Holder (Amendment to TC)			
2		Supplemental Type Certificate		
	Major Change to TC by non-TC Holder	STC ODA	STC DOA (under privileges 1, 2, 8*, 9*)	DOA Class D
	Minor Change to TC by non-TC Holder		STC DOA (under privileges 1, 2)	DOA Class C
3		Technical Standard Order**		
	TSO** design for an APU	TSO ODA	ETSO DOA (under privileges 1, 5)	DOA Class C
	TSO** design for all other articles		N/A (by EASA)	N/A
4		Repairs		
	Major Repairs Design	MRA ODA	TC/STC DOA (under privileges 1, 2)	DOA Class B
	Minor Repairs Design			DOA Class A

Notes:
* Optional
** For European, use the term European Technical Standard Order (ETSO)
EASA DOA's privileges based on Part 21 Subpart J 21.A.263:

1. to classify changes to a type-certificate or a supplemental type-certificate and repair designs as "major" or "minor";
2. to approve minor changes to a type-certificate or a supplemental type-certificate and minor repair designs;
3. (Reserved);
4. (Reserved);
5. to approve certain major repair designs under Subpart M to products or auxiliary power units (APUs);
6. to approve for certain aircraft the flight conditions under which a permit to fly can be issued following point 21.A.710(a)(2), except for permits to fly to be issued for point 21.A.701(a)(15);
7. to issue a permit to fly following point 21.A.711(b) for an aircraft it has designed or modified, or for which it has approved, following point 21.A.263(c)(6), the flight conditions under which the permit to fly can be issued, and where the holder of a design organization approval itself:
   (i) controls the configuration of the aircraft, and
   (ii) attests conformity with the design conditions approved for the flight;
8. to approve certain major changes to a type-certificate under Subpart D; and
9. to issue certain supplemental type-certificates under Subpart E and approve certain major changes to those certificates.

The Design Assurance Systems of FAA, EASA, and DGCA share a similar underlying concept, but they differ in their terminology and specific implementation methods. All three authorities emphasize the separation and distinction between the design function, which involves demonstrating compliance with design requirements, and the verification function, which ensures that the design complies with the requirements. Additionally, all three require design organizations to conduct self-audits or engage in independent monitoring to assess and verify organizational compliance. In the EASA and DGCA systems, this monitoring extends to all subcontracted design activities.

The three systems also display distinct characteristics. Notably, the implementation of a Safety Management System (SMS) is mandatory for DOAs and ODAs under the EASA and DGCA systems. EASA explicitly outlines the SMS requirements in Part 21.A.239 [6], while DGCA addresses SMS in CASR 19 [14]. However, CASR 21.239 and SI 21-10 do not explicitly mandate SMS implementation [10], [13]. In contrast, the FAA's SMS regulations, outlined in 14 CFR 5, are mandatory for Air Carriers and Commercial Operators but not for DOAs [15].

Table 2. Required Approvals for ODA/DOA in TCAS 7.1 Upgrade Modification Type Design Change

No.	Subject	FAA	EASA	DGCA
1	ODA / DOA Type	TC ODA (TC Holder) STC ODA (non-TC Holder)	TC ODA (TC Holder) STC ODA (non-TC Holder)	DOA Class D
2	Category Product		Large Aircraft	
3	Design Scope:		Avionics	
4	Functions / Privileges	- Approve Technical Data and Find Compliance to The Airworthiness Standards - Approve Airworthiness Limitations Information - Establish Conformity Inspection Requirements - Determine Conformity of Articles Including Test Articles - Determine Conformity of Test Setup - Determine Conformity of Installations of Articles, Including Tia Inspections on a Product - Perform Compliance Inspections - Perform Review and Acceptance of Instructions for Continued Airworthiness (ICA)	1. To classify changes to a type-certificate or a supplemental type-certificate and repair designs as "major" or "minor" 2. To approve for certain aircraft the flight conditions under which a permit to fly can be issued under point 21.A.710(a)(2), except for permits to fly to be issued for point 21.A.701(a)(15) *(optional)* 3. to issue a permit to fly under point 21.A.711(b) for an aircraft it has designed or modified, or for which it has approved, in accordance with point 21.A.263(c)(6), the flight conditions under which the permit to fly can be issued, and where the holder of a design organisation approval itself: (i) controls the configuration of the aircraft, and (ii) attests conformity with the design conditions approved for the flight *(optional)* 4. to approve certain major changes to a type-certificate under Subpart D *(optional)* 5. to issue certain supplemental type-certificates under Subpart E and approve certain major changes to those certificates. *(optional)*	1. To classify changes to type design and repairs as 'major' or 'minor'. 3. To issue information or instructions containing the following statement: The technical content of this document is approved under the authority of DOA nr. [DGCA], J. [xyz].' 4. To approve documentary changes to the aircraft flight manual, and issue such changes containing the following statement: 'Revision nr. xxx to AFM ref. yyy, is approved under the authority of DOA nr.[DGCA].J.[xyz].

Table 3. DOA or ODA Certification Procedure Comparison

Process Step	FAA ODA Process	EASA DOA Process	DGCA Indonesia Process	Remarks
Pre-Application	- Discuss the desire for ODA with the FAA. - Confirm FAA's needs and resources. - Initial discussions with appointing offices.	- Shape design needs and understand regulations. - Self-assessment using readiness checklist.	- Applicant submits Pre-Application Letter to DG - DG assigned MAC/DAAO to conduct an initial meeting with the applicant	- FAA consider the need and resources for ODA - EASA and DGCA only consider the design needs.

Process Step	FAA ODA Process	EASA DOA Process	DGCA Indonesia Process	Remarks
Application	- Apply to the appointing office with a Statement of Qualification.	- Submit the application using DOA form FO.DOA.00080. - Eligibility check by EASA.	- Submit a Formal Application using DAAO Form 21-101. - Acknowledgment by DGCA.	- The forms generally contain the Applicant's Identity and the type/scope of

Table 3. DOA or ODA Certification Procedure Comparison (continued)

Process Step	FAA ODA Process	EASA DOA Process	DGCA Indonesia Process	Remarks
	- Coordinate with multiple offices if necessary. - Initial screening by appointing office.	- DOATL allocated for readiness evaluation.	- Check by DOA Manager.	work/class of the Design Organization - The FAA requires that applicants have relevant experience working with the FAA and hold the required FAA certificates for the type of ODA authorization they are seeking.
Evaluation	- Initial screening by appointing office. - An evaluation panel (EP) was formed. - EP evaluates applications and conducts interviews	- Readiness Evaluation by DOATL. - Kickoff meeting with structured agenda. - CP1: First milestone based on the DOTL's sufficient confidence in the readiness level of the applicant	- DOA Team performs a technical evaluation of substantiated data.	Authorities implement distinct approaches to conduct evaluations.
Inspection	- Site visits and facility inspections by EP.	- No inspection or visit	- DOA Team inspects applicant's facilities, office, partners, subcontractors, laboratories, library, etc.	EASA's self-assessment approach eliminates inspections, while FAA and DGCA conduct inspections as part of the procedure.
Review	- Review of the organization and its system. - Questionnaire preparation and review.	- Review of the Handbook's organizational elements and processes. - Applicant's key personnel assessment of competence Part 21 compliance assessment with Compliance Checklist (Part 21 CCL). - CP2: The second milestone is based on the consolidated data from the applicant and synchronization between the EASA investigation step with the applicant's plan. - CP3: Part 21 CCL is proposed for review and	- Review of the complete system against Part 21 Subpart J.	

		approval to the Delegated DOATL.		

Table 3. DOA or ODA Certification Procedure Comparison (continued)

Process Step	FAA ODA Process	EASA DOA Process	DGCA Indonesia Process	Remarks
	-	A random check of the applicant's procedure compliance.	-	
Final Assessment and Report	- EP will notify the applicant of the result of the application. If it is denied, the applicant may usually appeal the FAA decision and will proceed by the Appeal Panel. If it is approved, the OMT and ODA Holder must prepare an MOU.	- Assessment of the processes in operation with the use of audit and/or review of the applicant's internal audit results/validation mechanism. - CP4: DOATL and Panel of Delegated DOATLs meeting. DOATL is authoring the Initial Investigation Report	- Certification final report prepared by DOAT Leader. - Final debriefs with the applicant.	The FAA system allows for appeals against denied applications. However, EASA's readiness checkpoint ensures that only fully prepared applicants reach the final assessment stage.
Issuing Approval Certificate	- Appointing office issue of letter of designation for ODA Panel. If it is approved, the OMT and ODA Holder must prepare an MOU.	- Accomplishment of the Administrative steps in the process. - Issue DOA Certificate and terms of approval. - Handbook approved by the DOA	- Conduct the Plenary meeting, Approval by the DOA Manager and confirmation of agreed terms of Approval - The DOA Certificate and associated terms of Approval will be prepared by the DO Manager and signed by the Director General (DG)	- FAA: Letter of Designation - EASA: DOA Certificate + Terms of Approval + DOA Handbook DGCA: DOA Certificate + Terms of Approval
Renewal and Upgrading	- Renewal based on compliance performance and the need for authorization. - Evaluated by OMT Completion of new MOU - Issuance of a new letter of designation	- No need for renewal since the approval is issued for an unlimited period and remains valid as long as the DO's compliance with the regulation.	- Renewal determined at annual report meeting. - DOAT Leader oversees renewal.	- FAA and DGCA Certificate or Letters need renewal No renewal for EASA Certificate

Changes to Approval	- Perform new applications for additional functions or a different type of ODA	- Changes in the Design Management System and Terms of Approval shall be approved by the Agency.	- Significant changes to the design assurance system and terms require a new application. - For non-Significant changes will be evaluated during continued surveillance.	- New application is required in FAA for additional functions of ODA, and in DGCA for significant changes to DAS and Terms of Approval - In EASA, no new application, only approval for change in DMS and Terms of Approval

Table 4. Design Assurance System Comparison

Item	FAA	EASA	DGCA
Element	Procedures Manual, Qualification, Responsibilities, Self-Audit	Safety Management Element, Design Assurance Element, Independent Monitoring Function, Handbook	Organizational structure, Responsibilities, Procedures/Manual Handbook, Resources, Independent Monitoring Function,
Safety Element	Investigating Safety Concerns for potentially unsafe, or non-compliant conditions	Safety Management Element (Safety Policy, Safety Objectives, Safety Action Group, Safety Management Key Process, Safety Communication, Safety Promotion, Safety Training)	Safety Management System, Ruled in CASR 19 (Safety Policy, Safety Objectives, SMS Implementation Plan, Safety Assurances, Safety Communication, Safety Promotion, Safety Training)
Procedures	Procedures Manual (Procedures for performing authorized functions, continued airworthiness function)	Design Assurance System (beginning of the design activities up to the continued airworthiness activities)	Design Assurance System (applicable CASRs requirements, product specifications and culminating with the issuance certificate), may be supported by DER
		Handbook (describes the organization)	Manual Handbook
		Limited Element for Minor Changes to Type Design or Minor Repairs to Products	Limited Element for Minor Changes to Type Design or Minor Repairs to Products
Responsibilities	Separation and distinction of the individual designee function and ODA unit member function	Separation of the showing compliance document preparation and compliance verification	Separation of the showing compliance document preparation and compliance verification

Table 4. Design Assurance System Comparison (continued)

Item	FAA	EASA	DGCA
Self-Audit / Self-Monitoring	Self-Audit: - Evaluate the ODA unit members, the ODA processes, and compliance with All applicable FAA regulations and policies. - the self-audit does not replace the FAA inspection required by this order - the procedures manual must contain the ODA holder's audit procedures. - Implementation of corrective action - Audit cycle: Max. 12 months	Independent Monitoring Function: - Verify compliance of the organization (including all subcontracted design activities) with the relevant requirements - Verify compliance with and adequacy of the Design management system. - Implementation of Corrective Action - If the organization have full control of the DMS, it can extend the audit/oversight cycle - Audit cycle: 24 months	Independent Monitoring Function: - Monitor the compliance with and adequacy of the documented procedures of the system - Implementation of Corrective Action - Audit cycle: 12 months

3.2. Aircraft Modification Certification Procedure, Study Case: TCAS 7.1 Software Upgrade

3.2.1. Design Description

Since 2012, false Traffic Collision Avoidance System (TCAS) Resolution Advisories (RAs) have been reported by various European Air Navigation Service Providers (ANSPs). The false RAs are caused on aeroplanes with a certain Honeywell TPA100B TCAS processor installed, through a combination of three factors: Hybrid surveillance enabled, processor connected to a hybrid GPS source, without a direct connection to a GPS source, and an encounter with an intruder aeroplane with noisy (jumping) ADSB Out position. If not corrected, this condition could lead to a loss of separation from other aircraft, possibly resulting in a midair collision. EASA has issued AD 20170091 to require the modification or replacement of Honeywell TPA100B TCAS P/N 9400351001 processors [16].

To further diminish the frequency of large altitude displacements during RA responses, Version 7.0 introduced new auditory announcements to complement weakening RAs and displayed a target vertical speed on the RA display for weakened RAs (‘green arc on weakening’). Version 7.1 will transition all AVSA RAs to Vertical Speed Limit (VSL) 0 fpm or LOLO RAs accompanied by an auditory annunciation of ‘Level Off, Level Off’. While this modification is intended to further minimize altitude deviations during weakened RAs, the sole use of VSL 0 fpm RAs will result in a slight increase in altitude clearance deviations relative to Version 7.0. While unnecessary deviations from ATC clearance continue to be a critical element in TCAS effectiveness, the number and severity of these excursions have been substantially reduced since TCAS’s introduction [17].

3.2.2. Classification of Change

The modification in this study is not classified as a substantial change that required a new type-certificate under the regulations of the FAR 21.19, EASA 21.A.19, and CASR 21.19 [6] [7][10]. This is because the modification does not involve changes in design, power, thrust, or weight that would be considered by the relevant aviation authorities to be extensive enough to require a substantially complete investigation for compliance with the applicable regulations or type-certification basis.

The classification of changes in type design as major or minor is a consistent practice among aviation authorities, as outlined in the regulations of the Federal Aviation Administration (FAA), the European Union Aviation Safety Agency (EASA), and the Civil Aviation Safety Regulations (CASR). According to FAA 21.93, EASA Part 21.A.91, and CASR 21.93, a “minor change” is characterized by having no appreciable effect on critical factors such as weight, balance, structural strength, reliability, operational characteristics, and other attributes influencing the airworthiness of the aircraft [6] [7][10].

EASA GM 21.A.91 provides examples of Major Changes per discipline [6]. This modification involves the introduction of new TCAS functions/systems, which aligns with the example provided for System discipline. Therefore, this modification should be classified as a major change.

3.3. Designation of the type certification basis for the changes to type-certificate

FAA, EASA and DGCA agreed that for a change to a type certificate and areas affected by the change comply with the requirement applicable on the date of the application for the change. However, for the change which is not significant and other exceptions mentioned in the regulations, an earlier amendment to the applicable requirement may be used [6] [7][10].

To determine the condition, it is necessary to categorize the changes into related and unrelated groups. Next, assess whether these changes constitute a significant change under FAR 21.101(b)(1), EASA 21.A.101.(b)(1) and DGCA SI 21-01 Point 1.2 [6][7][18]. Appendix A to GM 21.A.101 and Appendix A of AC.21.1011B provide examples of the significant changes [6]-[7]. Since the TCAS II V7.1 Modification employs a different processor that utilizes transponder and aircraft data to generate Resolution Advisories (RAs), it invalidates the assumptions made during the baseline product’s certification. Consequently, this modification falls under the category of “significant change”.

As a consequence, the affected area of this change should comply with the requirement applicable on the date of the application for the change. Based on the FAA AC 2015-1C, TCAS II system installations include the TCAS, the Mode S system, antennas, control panel and display components [17]. Then, we can consider that as the affected area of the change. The unaffected area can remain on the existing type certification basis.

3.4. Existing Certification Basis

The Certification Basis based on the Type Certificate of A320-200 by each authority is as follows:
FAA: Part 25 of the FAR effective February 1, 1965, including Amendments 25-1 through 25-56 thereto [19].
EASA:
- JAR 25 Change 11 (except paragraph 25.207 which remains at Change 10 and 25.853(a) and (b) which are at Change 13 since MSN 118) as elected by the Manufacturer.
- A320 Special Conditions, Experience Related Conditions and Harmonization Conditions.

(The amendments made to a particular basis on the occasion of further A320 model certification are identified per model) [20].
DGCA: For Indonesian-type certification purposes the certification basis is the applicable airworthiness requirement of the JAA at the time of the original certification at which the product was certified.
- JAR 25 Change 11 (except paragraph 25.207 which remains at Change 10) as elected by the Manufacturer.
- A320 Special Conditions, Experience Related Conditions and Harmonization Conditions.

(The amendments made to a particular basis on the occasion of further A320 model certification are identified per model) [21]

3.5. Requirement Affected by the Change

After identifying the affected area of the change, the following is a list of requirements of 14 CFR 25/CS 25/CASR 25 [22]-[23] that need to be redemonstrated to showcase compliance.:

Subpart F—Equipment
25.1301 Function and installation
25.1302 Installed systems and equipment for use by the flight crew.
25.1309 Equipment, systems, and installations.
25.1322 Flight-crew alerting.
25.1329 Flight guidance system.
25.1333 Instrument systems.

Subpart H—Electrical Wiring Interconnection Systems (EWIS)
25.1703 Function and installation: EWIS.
25.1705 Systems and functions: EWIS.
25.1707 System separation: EWIS.
25.1709 System safety: EWIS.
25.1729 Instructions for Continued Airworthiness: EWIS.

3.6. Authority Level of Involvement

The level of involvement of each authority in the certification process varies depending on the specific regulatory framework and the complexity of the design being certified. The explanations below elaborate on the level of involvement of FAA, EASA and DGCA:
FAA:
As listed in the FAA and Industry Guide to Product Certification [24], FAA Policy Memos AIR-100-15-140-PM17 [25] and AIR-100-15-150-PM16 [26] described the process for determining FAA Level of Project Involvement:

- For FAA Managed Project: Level of Project Involvement is determined by Risk Based Resource Management (RBRM) evaluation
- For ODA Managed Project: Full delegation to ODA holder except aspects of the project meet one of the few administrative, regulatory, or performance-related criteria that trigger the need for FAA involvement

EASA:

Regards to AMC 21.B.100(a) and 21.A.15(b)(6) [6]:

- Level of involvement defined by the risk classes and the critical consequences of noncompliance with the change.

DGCA:

Regards to SI 21-01 [18]:

- The DGCA-DOOA Level of Involvement is determined by the criticality of the decision or event to the safety of the product or the determination of compliance, the complexity of the rulemaking or ELOS determination, the novelty of the issue paper, the unusualness of the compliance findings, the DAAO's confidence in the applicant, the DOA's experience and internal processes, and the DAAO's confidence in the DOA's privileges.

4. Conclusion

The designated representatives and design organizations among FAA, EASA, and DGCA have different systems. FAA utilizes both Individual Representative and Organization Designation Authorization programs. EASA solely employs Design Organisation Approval (DOA) organizations. Furthermore, DGCA Indonesia adopts a hybrid approach, offering a comprehensive system with distinct designations for individuals and organizations.

While the FAA, EASA, and DGCA share a common approach to Design Assurance Systems, they differ in their specific implementation details and mandates. One notable distinction is the requirement for a Safety Management System (SMS), which is mandatory for DOAs under EASA and DGCA but not for ODAs under FAA regulations.

FAA, EASA, and DGCA generally have the same procedures regarding Certification Procedure for Aircraft Modification which is examined by TCAS 7.1 Upgrade Modification Study Case. The authorities' level of involvement is specifically defined differently. However, all authorities emphasize the consideration of risk factors in determining project involvement. The complexity of the project or rulemaking is consistently identified as a crucial factor, with safety implications and compliance determinations playing pivotal roles in the decision-making process for all authorities.

5. Acknowledgement

I would like to express my sincere gratitude to the Institut Teknologi Bandung (ITB) and École Nationale de l'Aviation Civile (ENAC) for their unwavering support and guidance throughout this research. I am also deeply grateful to the Badan Pengembangan Sumber Daya Manusia Perhubungan (BPSDM Perhubungan) for their generous scholarship and funding, which has enabled me to pursue this study and research aspirations.

References

[1] Y. Kun and L. Cunxi, "Comparison on the Ways of Airworthiness Management of Civil Aircraft Design Organization," *Procedia Eng*, vol. 17, pp. 388–395, 2011, doi: 10.1016/j.proeng.2011.10.045.

[2] W. Tao, H. Zeng, and X. Rong, "Research on Design Assurance System with the Development of CAAC's Design Organization Management," *Procedia Eng*, vol. 80, pp. 224–230, 2014, doi: 10.1016/j.proeng.2014.09.082.

[3] B. B. Winkeler, D. de Andrade, and M. V. R. de Oliveira, "Analysis of the Organization Designation Authorization in Aircraft Certification: Differences to the Brazilian and European Approaches," *Journal of Aerospace Technology and Management*, vol. 14, 2022, doi: 10.1590/jatm.v14.1279.

[4] N. N. Ramadhanti, "A Comparative Analysis of Regulation and Recommendations for Streamlining Certification Basis Definition in Aircraft Modification Process," Institut Teknologi Bandung, Bandung, 2023.

[5] Rasmussen University Library and Learning Services, "How do I write a comparative analysis?," rasmussen.libanswers.com. Accessed: Jun. 23, 2023. [Online]. Available: https://rasmussen.libanswers.com/faq/248312

[6] European Union Aviation Safety Agency, *Easy Access Rules for Airworthiness and Environmental Certification (Regulation (EU) No 748/2012)*, Revision. Jerman: European Union Aviation Safety Agency, 2023.
[7] Federal Aviation Administration, *Part 21 - Certification Procedures for Products and Articles*. Code of Federal Regulations, 2009. Accessed: Oct. 23, 2023. [Online]. Available: https://www.ecfr.gov/current/title-14/chapter-I/subchapter-C/part-21?toc=1
[8] Federal Aviation Administration, *Part 183 - Representatives of Administrator*. Code of Federal Regulations, 2005. Accessed: Oct. 27, 2023. [Online]. Available: https://www.ecfr.gov/current/title-14/chapter-I/subchapter-K
[9] Kementerian Perhubungan, *KM 39 Year 2001 - CASR Part 183 Representatives of the DGCA*. Indonesia, 2001. Accessed: Dec. 22, 2023. [Online]. Available: https://imsis-djpu.dephub.go.id/PortalDKPPU/ReadRegulation.php?id=YTg3ZmY2NzlhMmYzZTcxZDkxODFhNjdiNzU0MjEyMmM=
[10] Kementerian Perhubungan, *PM 98 Year 2015 - CASR 21 Certification Procedures for Product and Parts*. Indonesia, 2015. Accessed: Dec. 05, 2023. [Online]. Available: https://imsis-djpu.dephub.go.id/assets/file/casr/CASR%20Part%2021%20Amdt.%202%20-%20Certification%20Procedures%20for%20Product%20and%20Part.pdf
[11] Federal Aviation Administration, *Order 8100.15B - Organization Designation Authorization Procedures, Including Change 3*. United States: Federal Aviation Administration, 2018. Accessed: Dec. 22, 2023. [Online]. Available: https://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.information/documentID/1021171
[12] European Union Aviation Safety Agency, *DOA Initial Investigation Information Paper*. cologne: European Union Aviation Safety Agency, 2022. Accessed: Dec. 22, 2023. [Online]. Available: https://www.easa.europa.eu/en/domains/aircraft-products/design-organisations/design-organisations-approvals#group-easa-downloads
[13] Kementerian Perhubungan, *KP 105 Year 2013 - SI 21-10 Certification Procedure for Design Organization Approval (DOA)*. Indonesia, 2013. Accessed: Dec. 05, 2023. [Online]. Available: https://imsis-djpu.dephub.go.id/PortalDKPPU/ReadRegulation.php?id=ZTRkYTNiN2ZiYmNlMjM0NWQ3NzcyYjA2NzRhMzE4ZDU=
[14] Kementerian Perhubungan, *PM 62 Year 2017 - CASR 19 Safety Management System*. Indonesia, 2017. Accessed: Dec. 05, 2023. [Online]. Available: https://imsis-djpu.dephub.go.id/assets/file/casr/CASR%20Part%2019%20-%20Safety%20Management%20System.pdf
[15] Federal Aviation Administration, *Part 5 - Safety Management System*. United States: Federal Aviation Administration, 2015. Accessed: Oct. 23, 2023. [Online]. Available: https://www.ecfr.gov/current/title-14/chapter-I/subchapter-A/part-5
[16] European Aviation Safety Authority, *AD No. 2017-0091R2 ATA 34 – Navigation – Traffic Collision Avoidance System Processor – Modification (Software Update) / Replacement*. Cologne: European Aviation Safety Authority, 2011. Accessed: Dec. 05, 2023. [Online]. Available: https://ad.easa.europa.eu/ad/2017-0091R2
[17] Federal Aviation Administration, *TCAS II V7.1 Intro booklet*. Federal Aviation Administration, 2011. Accessed: Dec. 22, 2023. [Online]. Available: https://www.faa.gov/documentlibrary/media/advisory_circular/tcas%20ii%20v7.1%20intro%20booklet.pdf
[18] Kementerian Perhubungan, *KP 174 Year 2017 - SI 21 - 01 Type Certification Procedures*. Indonesia, 2017. Accessed: Dec. 22, 2023. [Online]. Available: https://imsis-djpu.dephub.go.id/assets/file/si/SI%2021-01%20Edition%201%20-%20Type%20Certification%20Procedures.pdf
[19] Federal Aviation Administration, *Type Certification Data Sheet A28NM*. United States: Federal Aviation Administration, 2023. Accessed: Dec. 05, 2023. [Online]. Available: https://drs.faa.gov/browse/TCDSMODEL/doctypeDetails?modalOpened=true
[20] European Union Aviation Safety Agency, *Type-Certificate Data Sheet No. EASA.A.064*. Cologne: European Union Aviation Safety Agency, 2023. Accessed: Dec. 05, 2023. [Online]. Available: https://www.easa.europa.eu/en/document-library/type-certificates/aircraft-cs-25-cs-22-cs-23-cs-vla-cs-lsa/easaa064-airbus-a318
[21] Kementerian Perhubungan, *Aircraft Type Certificate Data Sheet No. A061* . Indonesia, 2012. Accessed: Dec. 05, 2023. [Online]. Available: https://imsis-djpu.dephub.go.id/assets/file/type_certificate/A061%20Rev.%2003.pdf
[22] Federal Aviation Administration, *Part 25 - Airworthiness Standards: Transport Category Airplanes*. United States: Code of Federal Regulations, 2023. Accessed: Oct. 27, 2023. [Online]. Available: https://www.ecfr.gov/current/title-14/chapter-I/subchapter-C/part-25?toc=1
[23] Kementerian Perhubungan, *PM 44 Year 2014 - CASR Part 25*. Indonesia, 2014. Accessed: Dec. 22, 2023. [Online]. Available: https://imsis-djpu.dephub.go.id/PortalDKPPU/ViewTCDetail.php?id=ODYxMzk4NWVjNDllYjhmNzU3YWU2NDM5ZTg3OWJiMmE=
[24] Aerospace Industries Association, Aircraft Electronics Association, Federal Aviation Administration, and GAMA, *The FAA and Industry Guide to Product Certification*, 3rd ed. United States: Federal Aviation Administration. Accessed: Dec. 22, 2023. [Online]. Available: https://www.faa.gov/sites/faa.gov/files/aircraft/air_cert/design_approvals/transport/CPI_guide.pdf
[25] Federal Aviation Administration, *Federal Aviation Administration Memorandum No. AIR100-15-140-PM17 Subject: Guidance on Recognition and Use of Applicant Showings in Organization Designation Authorization (ODA) Projects*. United States: Federal Aviation Administration, 2015.
[26] Federal Aviation Administration, *Federal Aviation Administration Memorandum No. AIR100-15-150-PM16 Subject: Guidance for Recognition and Use of Applicant Showings on Standard Certification Projects*. United States: Federal Aviation Administration, 2015.