Research Paper
Journal of Aerospace System Engineering
Vol.14, No.6, pp.44-57 (2020)
EISSN 2508-7150
http://dx.doi.org/10.20910/JASE.2020.14.6.44

Study on the Improvement of AMO Certification and Surveillance System

Yunseon Choe[1,†], Sunkyung Lee[2], Hagirl Chung[2], Daeyoung Jung[2] and Howon Hwang[2]

[1]Incheon Industry-Academy Collaboration Institute
[2]Korea Aerospace University

Abstract

The ICAO AMO global recognition system will be instituted in 2024, with the aim of reducing the certification and surveillance burden on aviation authorities and approved maintenance organizations (AMOs). If the domestic AMO certification and surveillance system is internationally recognized through this system, it may facilitate the rapid development of the domestic MRO industry in South Korea. To ensure international recognition of the domestic AMO system, the AMO surveillance and regulation system must be improved. This study reviewed ICAO policies, standards, guidelines, and leading aviation authorities' regulations and systems with regard to maintenance organization certification and surveillance, and a comparative analysis with the domestic system was conducted. From this, gaps in aviation safety inspection personnel training, qualification, and surveillance were identified, and measures for improving inspection personnel training and organization certification and surveillance system maintenance were elucidated to preemptively respond to the ICAO AMO global recognition system.

Key Words : AMO, ICAO, AMO Global Recognition, Certification and Surveillance, MRO

1. Introduction

The International Civil Aviation Organization(ICAO) has developed and implemented measures to establish a global recognition system for approved maintenance organizations(AMOs) by 2024 and minimize overlapping surveillance activities by bi- or multilaterally recognizing AMOs approved in each contracting state. The ICAO roadmap to achieving this global recognition system is shown in Figure 1[1].

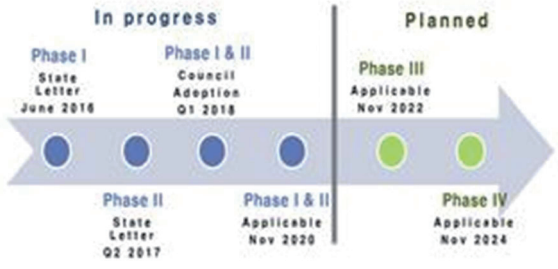

Fig. 1 ICAO AMO Global Recognition Roadmap

Received: Aug. 30, 2020 Revised: Sep. 23, 2020 Accepted: Sep. 28, 2020
† Corresponding Author
Tel: +82-10-9497-8262, E-mail: yschoe@iiaci.or.kr

As part of Phase I and II, the ICAO standards and guidelines to establish the AMO global recognition system are being revised, including the standardization of the AMO certificate and maintenance approval rating system as well as the stipulation of the basis for AMO recognition. Y. S. Choe raised the need for proactive preparation and response in South Korea to the revision of ICAO standards and guidelines[2]. In Phase III, specific AMO approval and recognition standards will be included in the ICAO Doc 9760 Airworthiness Manual, which will be modeled on the international-level standards of leading aviation authorities, such as those of the U.S. Federal Aviation Administration(FAA) and the European Union Aviation Safety Agency(EASA), as officially announced by ICAO[1].

According to the First Aviation Policy Master Plan announced by the Ministry of Land, Transport and Maritime Affairs(currently the Ministry of Land, Infrastructure and Transport) in 2009, the development of the domestic aviation industry thus

far has primarily focused on the air transportation sector, and it has been difficult to establish firms specializing in aviation maintenance repair overhaul(MRO) industry, other than airlines' maintenance departments, due to high initial investment costs. Moreover, the need to foster aviation maintenance business at the national level was reported in the Master Plan in anticipation of the growing global MRO industry and increasing demand for maintenance of low-cost carriers in South Korea[3]. Since then, dedicated MRO firms independent of air carriers have begun to emerge in South Korea, albeit still in early stages, with active discussions on fostering the MRO industry at the national level. However, the national certification and surveillance system, which is essential for identifying the level of MRO quality, has not been addressed in-depth or beyond the commercial scope when discussing measures to foster the domestic MRO industry.

Considering the domestic and international circumstances with respect to AMOs, it is necessary to promote the development of the domestic MRO industry by providing the ecosystem for MRO through business support and advance domestic AMO certification and surveillance systems to the international level. A bi- or multilateral aviation safety agreement with leading aviation countries and maintenance organizations through the global recognition system that ICAO intends to implement can indicate to the MRO market that South Korean AMOs are competent at an international level. In this study, measures to improve the domestic AMO certification and surveillance system are proposed through the review of ICAO standards and guidelines and regulations reported by the leading aviation authorities as well as a comparative analysis of domestic regulations with respect to key elements of the preemptive response to the ICAO AMO global recognition system.

2. ICAO Standards and Guidelines

2.1 ICAO Standards

The ICAO standards, partially implemented on November 11, 2020 as part of the ICAO global recognition system roadmap Phase III, stipulate that aircraft, engines, propellers, and other parts be maintained by an AMO approved by the state of registry or contracting state that is recognized by the registry state. It is also stipulated that, when the state of registry approves an AMO or recognizes one approved by a contracting state, the state of registry must guarantee that the AMO meets the requirements of the state of registry[4]. This implies that the effective certification and surveillance system of the state of registry or the ability to verify the approval system of other contracting states is a prerequisite of the AMO global recognition system.

2.2 ICAO Guidelines

2.2.1 AMO Certification and Surveillance Personnel

The ICAO Doc 9760 Airworthiness Manual recommends that an effective organization and qualified personnel should be available to ensure the function of a national aviation authority. The structure of the airworthiness division within a national aviation authority as suggested in the Airworthiness Manual is shown in Fig. 2.

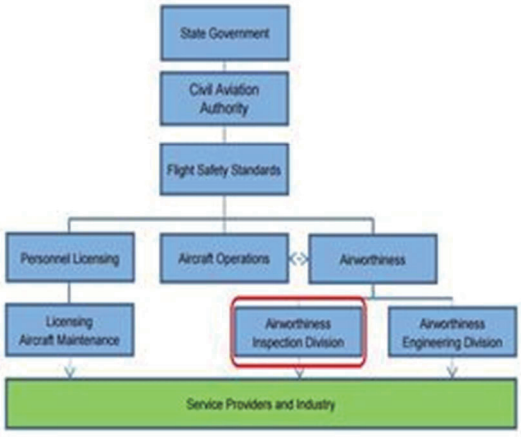

Fig. 2 State's Airworthiness Organizational Chart

The divisions responsible for airworthiness are divided into airworthiness engineering division(AED) and airworthiness inspection division(AID). A summary of the personnel and duties that constitute AED and AID is provided in Table 1.

Table 1 AED/AID Personnel and Duties

Division	Personnel	Duties
AED	Airworthiness Engineer	- Design and production approval, technical data approval for major repair and modification - Surveillance of type certification, change to type certification, and other engineering duties
AID	Airworthiness Inspector	- Approval of airworthiness-related duties(maintenance) - Inspection and supervision of air operators and AMO - Evaluation and approval of repair and modification

The certification and surveillance of AMOs are conducted by AID airworthiness inspectors, who are subject to the basic requirements suggested by ICAO, as summarized in Table 2. It is recommended that the ideal candidate for an airworthiness inspector has work experience in a relevant organization or division responsible for maintenance or inspection and is appointed as an airworthiness inspector after completing the necessary specialty training[5]. This demonstrates the importance of field expertise to effectively perform the duties as an inspector.

Table 2 AID Inspector Basic Requirements

Type	Requirements
Knowledge	Knowledge of aircraft airworthiness maintenance - Maintenance program, maintenance check, maintenance record, quality system, etc.
Experience	More than five years of experience in aircraft maintenance - AMO, airline/air operator maintenance facility, training organization, and military experience
Qualification	Aircraft maintenance technician license

2.2.2 Inspection System

In accordance with Article 12 of the Convention on International Civil Aviation, a contracting state shall guarantee aviation safety by specifying compliance with the ICAO standards in the safety inspection. The ICAO Doc 9760 Airworthiness Manual recommends the establishment of a national aviation legislation system to proactively inspect and regulate civil aviation activities in a contracting state and the inspection procedure to certify and continuously validate AMOs, air operators, and maintenance training organizations for safe aircraft operation. It is also suggested that a national surveillance program should be operated appropriately for the scale of the national aviation industry and that surveillance should be conducted either regularly or irregularly, at least once per year.

Currently, no specific guidance from ICAO is available on risk-based safety inspection activities that are being performed on AMOs in some countries, including the U.S., to maximize the efficiency of the national resource utilization and safety inspection. However, the application of a risk-based inspection system for AMOs is suggested in the ICAO Quick Reference Guide(QRG), which provides measures to mitigate or resolve the limited inspection activities of AMOs in contracting states due to the recent COVID-19 outbreak[6]. Mitigation measures, such as reducing the number of inspection subjects and extending the inspection frequency of AMOs, are implemented in a risk-based approach, and a temporary agreement is encouraged to delegate inspection activities to the country where AMOs are located when overseas travel is restricted. It is considered difficult to reach a temporary agreement if the AMO inspection system is delegated without the completion of a safety risk assessment. This ICAO QRG not only serves as an opportunity to reaffirm the need for the AMO global recognition system, but it also signifies that a risk-based AMO inspection system is proposed by ICAO.

3. Systems in Leading Aviation Countries

3.1 U.S. FAA

3.1.1 Basic Requirements of Airworthiness Inspector

In the FAA, airworthiness inspectors are divided into maintenance and avionics fields, and the basic requirements of inspectors in each field are listed in Table 3[7].

Table 3 FAA Airworthiness Inspector Requirements

Type	Maintenance	Avionics
Knowledge	Ability to perform duties is evaluated through interviews	
Experience	- Aircraft/engine maintenance - AMO, airlines, military, or government experience - Practical aircraft maintenance experience within last three years	-Avionics maintenance - AMO, airlines, military, or government experience - Practical avionics maintenance experience within last three years
Qualification	FAA airframe & powerplant mechanic certificate	-

These basic requirements of airworthiness inspectors are similar to those suggested by ICAO, except for the experience requirement for maintenance airworthiness inspectors.

3.1.2 Requirements of AMO Inspector Appointment

The appointment of aviation safety inspectors, including airworthiness inspectors, requires the completion of mandatory training to perform essential work duties. The mandatory training for new aviation safety inspectors includes indoctrination training, specialty training/job function training, and on-the-job training(OJT). The specialty training for AMO certification and surveillance is organized by the FAA Academy, a dedicated training institute for FAA personnel, and consists of 40 hours of coursework that include the knowledge and techniques required for AMO certification and surveillance[8]. Inspectors performing inspection activities on behalf of countries that have entered into an aviation safety agreement are required to possess regulatory knowledge and recognition/surveillance experience and to complete the relevant specialty training[9].

3.1.3 AMO Certification and Surveillance System

The U.S. Code Title 49 stipulates that an AMO located outside the U.S. be inspected at least once per year[10]. An AMO located in the U.S. is inspected every 12 months at least, but the specific areas of inspection of the AMO may be subdivided, whereby those with low risk levels may be inspected every 24 months.

The FAA has operated the Safety Assurance System(SAS) since 2016 to ensure the safe operation of U.S. aircraft through risk analysis and AMO evaluation and to efficiently operate limited inspection personnel for ever-increasing AMO inspection activities. SAS is a risk-based data support inspection system that identifies risk factors within an AMO and manages risks at an acceptable level based on the FAA's policies, regulations, and procedures.

SAS's inspection system model consists of five-step modules: configuration → planning → resource management → data collection → analysis, assessment, and action. The relationship between the modules is schematized in Fig. 3, and the main tasks of each module are summarized in Table 4[9].

Fig. 3 SAS Oversight Model

Table 4 Description for five process modules

Module	Type	Task
1	Configuration	AMO operation profile management
2	Planning	AMO certification and surveillance planning
3	Resource Management	AMO certification and surveillance performance, inspector formation and assignment
4	Data Collection	AMO certification and surveillance performance
5	Analysis, Assessment, and Action	AMO certification and surveillance result analysis, assessment, and action

The data collection tools (DCTs) used in Module 4 consist of 39 types of DCTs by inspection area, similar to the Korean aviation safety inspector's checklist, and each question falls under one or more of the seven safety attribute categories (responsibility, authority, procedure, control, process management, correlation between processes, and safety awareness) to identify the safety attributes of an AMO and evaluate risk levels when analyzing collected data. If the DCTs confirm that the AMO system may lead to unstable conditions, the basic inspection frequency(6/12/24 months) set for each inspection area may be shortened, but if the collected data indicate good conditions, the inspection frequency may not be extended. This process ensures quality inspections by focusing on the vulnerable areas of an AMO through risk analysis and assessment.

3.2 EASA

3.2.1 AMO Inspector Requirements

The requirements of an AMO inspector, as set out in the EASA Part-145 AMO certification standard, are listed in Table 5[11].

3.2.2 AMO Inspector Specialty Training

AMO certification and surveillance inspectors must complete the specialty training(including initial and recurrent training) on EASA Part-145. Training is provided by the training institutes designated by EASA, one of which is the JAA Training Organization that runs a two-day course on the Part-145 requirements and applicable laws/administrative rules to aviation authority inspectors and industry personnel[12].

Table 5 FAA AMO Inspector Requirements

Type	Description
Knowledge	Comprehensive knowledge of regulations and quality systems relevant to aircraft airworthiness maintenance
Experience	Practical experience in maintenance (five years)
Education	Completion of auditing techniques training
Education or Qualification	Aviation maintenance engineer or technician qualification related to aircraft and airworthiness maintenance

3.2.3 Certification and Surveillance System

EASA stipulates that AMOs located in EASA member countries are subject to inspection activities at intervals not exceeding 24 months after initial certification while those located outside EASA member countries are inspected at least once per year[13]. However, the frequency and scope of inspection may vary within the principles depending on the characteristics of an AMO.

In the Notice of Proposed Amendment(NPA) 2019-05(C) published in 2019, EASA announced that AMOs will be subject to risk-based surveillance activities in the future. With the aim of operating inspection programs that base the inspection scope on past inspection activities and safety priorities, the relevant regulations are being revised such that the inspection scope and frequency are determined according to an AMO's characteristics, work scale, past inspection results, and applicable risk analysis[14].

4. Domestic AMO Certification and Surveillance System

4.1 Review and Analysis of Domestic Laws and Regulations

The current safety laws and regulations applicable to AMO aviation safety activities are listed in Table 6[15].

Table 6 Domestic Laws and Administrative Rules on Aviation Safety Activities for AMO

Type	Applicable Provision
Aviation Safety Act	Article 97 (maintenance organization certification, etc.)
	Article 98 (revocation of maintenance organization certification, etc.)
	Article 99 (penalties for approved maintenance organization)
	Article 132 (aviation safety activities)
	Article 135 (delegation and commission of authority)
Aviation Safety Act Enforcement Decree	Article 26 (delegation and commission of authority) ※ Delegation of the following provisions of the Aviation Safety Act - Article 97 (maintenance organization certification, etc.) - Article 98 (maintenance organization certification, etc.) - Article 99 (penalties for approved maintenance organization)
Public Notice	Flight Safety Regulations (No. 2019-246) Chapter 6 Certification of Maintenance Organization
Directive	Assessment Guidelines for Maintenance Organization Certification (No. 1298) Article 13 (aviation safety inspection, etc.)
	Aviation Safety Inspector's Administrative Rules (No. 1147)
Guideline	Aviation Safety Inspector's Manual (No. 282)

4.1.1 Aviation Safety Act

The aviation safety inspection activities directed by the Minister of Land, Infrastructure and Transport for personnel performing the maintenance of aircraft, equipment, or parts, including AMOs, are based on Article 132 of the Aviation Safety Act. However, since AMO certification and surveillance are delegated by the Minister of Land, Infrastructure and Transport to the Directors of the Regional Aviation Offices under Article 135 of the Aviation Safety Act and Article 26 of the Enforcement Decree of the same Act, the Directors of the Regional Aviation Offices, which are agencies of the Minister of Land, Infrastructure and Transport, are in charge of AMO certification and surveillance in Korea.

4.1.2 Administrative Rules(Public Notice, Directive, and Guildeline)

The Flight Safety Regulations, Chapter 6(6.5.12), which serves as the standard for AMO certification, provides the grounds for frequent inspection of AMOs by the Minister of Land, Infrastructure and Transport. According to Article 13 (Air Safety Inspection) of the Assessment Guidelines for Maintenance Organization Certification under the Ministry of Land, Infrastructure and Transport Directive commissioned upon Article 97 of the Aviation Safety Act, the Director of a Reginal Aviation Office is required to establish and conduct an annual inspection for AMOs by applying the aviation safety inspector's administrative rules and report the results to the Minister of Land, Infrastructure, and Transport(Director of Aviation Safety). The duties of an aviation safety inspector include the regulation of activities necessary for airworthiness certification, flight certification, maintenance organization certification, and aviation safety, which is either directed by the Minister of Land, Infrastructure and Transport or the Director of a Regional Aviation Office, as shown in Table 7. The Aviation Safety Inspector's Manual contains the details necessary for performing inspection work under the Air Safety Inspector's Administrative Rules. The Minister of Land, Infrastructure and Transport shall oversee the inspection activities of international air transport operators, and the Administrator of Regional Offices of Aviation shall oversee the inspection activities of other air transport operators, aircraft operators, and AMOs.

Table 7 Classification of Regulatory Duties

Type	Requirement
Minister of Land, Infrastructure and Transport	- International air transport business operator certificate holder - Foreign international air transport operator or foreign nationality aircraft operator in Korea
Administrator of Regional Offices of Aviation	- Domestic air transport business operator certificate holder - Small air transport business operator certificate holder - Aircraft use business operator - Maintenance organization certificate holder - Private aircraft operator

Aviation safety inspectors that perform aviation safety inspection activities are divided into airworthiness inspectors and flight inspectors, as shown in Table 8[16].

Table 8 Related Provisions of Aviation Safety Acts for Aviation Safety Inspectors

Type	Subject Task (Aviation Safety Act)
Airworthiness Inspector	- Article 24 (inspection approval) - Article 25 (proof of noise compliance) - Article 26 (requests due to changing aircraft technology standards) - Article 27 (technical standard product type approval) - Article 28 (proof of manufacturer of parts, etc.) - Article 90 (certificate of operation of air transport operator) - Article 97 (maintenance organization certification, etc.) - Airworthiness compliance terms for foreign air transport operators under Article 104, Clause 3 - Aviation safety activities in the area of airworthiness under Article 132, Clause 2
Operation Inspector	- Article 90 (proof of operation of air transport operator) - Flight compliance terms of foreign air transport operators under Article 104, Clause 3 - Aviation safety activities in the area of flight under Article 132, Clause 2

4.2 Requirements of Aviation Safety Inspector

4.2.1 Airworthiness Inspector Experience Requirements and Qualifications

The basic requirements of airworthiness inspectors in South Korea are divided into qualifications and experience depending on the inspection subject. Among the qualifications, an aviation maintenance technician certificate is required. Table 9 shows the experience requirements for different inspection subjects, which do not include AMOs.

According to Articles 3(Definitions) and 4 (Appointment of Inspector) of the Assessment Guidelines for Maintenance Organization Certification under the Ministry of Land, Infrastructure and Transport Directive, Administrator of Regional Offices of Aviation appoints an airworthiness inspector to perform AMO certification duties, preferably who possesses five or more years of practical experience as an aviation safety inspector. While an airworthiness inspector that holds the certificate of aviation maintenance technician and satisfies the requirements for each inspection subject listed in Table 9 can be appointed, these qualification and experience requirements are considered inadequate for AMO certification and surveillance duties because AMOs are not designated as an inspection subject.

Table 9 Experience Requirements for Airworthiness Inspectors

Type	Requirements
International Air Transport Operator	Level A: 10 or more years in international air transport field Level B: 5 or more years in international air transport field

Domestic Air Transport Operator	Level A: 10 or more years in domestic air transport field Level B: 5 or more years in domestic air transport field
Small Transport Operator	5 or more years in air transport field
Aircraft Operator	5 or more years in air transport field
Private Aircraft Owner	5 or more years in air transport field

4.2.2 Training Program for Airworthiness Inspector

An airworthiness inspector shall complete the training listed in Table 10 before and after being appointed.

Table 10 Training Program for Airworthiness Inspectors

Type	Course/Time	Note
Initial Training	16 areas/70 hours	AMO (3 hours)
Primary Job Training	25 areas/70 hours	Inspector appointment upon completion
Secondary Job Training	13 areas/70 hours	AMO inspection included (14 hours)
Recurrent Training	7 areas/28-35 hours	Every 12 months
Specialty Training	9 areas	No specialty training for AMO

The initial training includes establishing a basic understanding of AMO and the introduction of relevant laws(3 hours), and secondary job training covers AMO inspection(14 hours). The specialty training is required if the Minister of Land, Infrastructure and Transport or the Administrator of Regional Offices of Aviation believes it to be necessary and is completed by setting up a separate curriculum or through curricula conducted by a foreign training institute. The training primarily includes areas that are not pertinent to AMO inspection, such as the proof of flight of air transport operators, reliability management, and foreign aircraft inspection procedures. The training of airworthiness inspectors is conducted by external experts at the Ministry of Land, Infrastructure, and Land Education Center when deemed necessary by the Ministry.

4.3 AMO Surveillance System

The aviation safety surveillance system in South Korea is divided into recurrent and special inspections. Recurrent inspection is conducted by aviation safety inspectors by applying the specified inspection fields and checklists, and special inspection is conducted in addition to recurrent inspection. The details of the comparison are provided in Table 11[16].

Table 11 Aviation Safety Surveillance System

Type	Inspection Type	
Recurrent Inspection	Required Inspection	Conducted once or more per year
	Planned Inspection	Conducted if necessary in addition to required inspection
Special Inspection	Intensive Inspection	Conducted in a separate plan through analysis/ assessment of recurrent inspection results
	Potential Risk Inspection	Conducted in a separate plan to determine potential risks through comprehensive analysis of aircraft accidents, airline operation condition and trend, aviation business status and to systematically manage safety conditions

The Aviation Safety Inspector's Manual defines the required inspection items of the recurrent and planned inspections and contains a checklist for each inspection item. However, AMOs do not appear to be in the Manual for the following reasons. First, while AMOs are included in the general rules and purpose of the Aviation Safety Inspector's

Manual, Volume 1, it is not addressed in the main text concerning inspection subjects and frequency. Second, the AMO checklist provided in the Airworthiness Inspector's Manual, Volume 3 is not relevant to the maintenance of AMO certification but rather to the air transport operators that hold the AMO certificate or AMOs contracted by air transport operators. This can be confirmed in the purpose and goals stated within the checklist subject to air transport operators. Lastly, although "Certified AMO(inspection code: AW400)" is included in the list of inspection items of Regional Aviation Offices in the Manual, Volume 1, Annex 4, AMOs are excluded from the list of recurrent inspection subjects, and no corresponding checklist is provided in the Regional Aviation Offices' checklists in the Manual, Volume 4.

Conversely, Article 13 in the Assessment Guidelines for Maintenance Organization Certification of the Ministry of Land, Infrastructure and Transport's Directive, delegated under Article 97 of the Aviation Safety Act, stipulates that an annual safety inspection plan for AMOs shall be established and inspected in accordance with the Air Safety Inspector's Administrative Rules and that AMO quality data are analyzed and evaluated in areas of concern for aviation safety. In addition, the AMO checklist(AW400) for inspection performance is listed in the Annex of the Assessment Guidelines for Maintenance Organization Certification.

In summary, the rules of the aviation safety inspector's duties stipulated in the Assessment Guidelines for Maintenance Organization Certification for AMO inspection activities mainly focus on the inspection of air transport operators and aircraft operators and do not correspond with AMO inspection activities. Moreover, AMO inspection is subject to a single checklist that compiles all AMO maintenance requirements, unlike the checklist for air transport operators with specifically categorized items, and lacks the reference for AMO inspection frequency while the Assessment Guideline requires an annual inspection plan.

5. Comparative Analysis of AMO Certification/Surveillance Systems

The results obtained from comparing the AMO certification and inspection systems between the ICAO guidelines, leading aviation countries, and South Korea are provided below.

Table 12 Comparison of AMO Airworthiness Inspector Requirements

Type	Qualification	Experience
ICAO	Aviation Maintenance Technician License	Over five years of work experience at AMOs, aircraft operator's maintenance facilities, maintenance training institutes, or military maintenance facilities
FAA	Airframe & powerplant Mechanic certificate	Practical experience in aircraft maintenance within last three years (working at AMOs, airlines, or military and government agencies)
EASA	Aviation Maintenance Technician or Aviation Engineering degree	Over five years of practical maintenance experience
South Korea	None	None

5.1 Basic AMO Inspector Requirements

The comparison of the AMO airworthiness inspector requirements between ICAO, leading aviation countries, and South Korea are summarized in Table 12. In South Korea, the qualification and experience requirements of airworthiness inspectors for AMOs are not specified.

5.2 Training Program for Airworthiness Inspectors

The training program to develop expertise in AMO certification and surveillance is compared between the leading aviation countries and South Korea, as shown in Table 13.

Contrary to leading aviation countries, no specialty training program for AMO certification and surveillance is held in South Korea other than initial training. South Korean airworthiness inspectors sometimes participate in specialty training on AMOs

through a foreign training curriculum, but this is not included in the Aviation Safety Inspector's Administrative Rules nor in the requirements for appointing airworthiness inspectors. Moreover, while the FAA operates training programs at an affiliated training center, the FAA Academy, and EASA recognizes the training programs at designated aviation training institutes, there is no training institute designated for inspector training programs in South Korea. Although the operation of a dedicated training center for airworthiness inspectors in South Korea may be inefficient considering the smaller scale of the aviation maintenance industry compared to those of the leading aviation countries, specialty training programs to prepare for the AMO global recognition system and measures to systematically and competently implement such programs are necessary.

Table 13 Training Program Comparison

Type	Training Program	Note
FAA	AMO certification and surveillance	40 hours
EASA	AMO certification requirement	16 hours
	Auditing techniques	-
South Korea	AMO training during initial inspector training (understanding of AMO and introducing laws and regulations)	3 hours

5.3 AMO Surveillance System

ICAO's guideline on the AMO surveillance system and the current state of operation in the leading aviation countries and South Korea are summarized in Table 14. ICAO's guideline and the leading aviation countries require inspection activities to be conducted at a predetermined interval or at a regular interval that is adjustable. In South Korea, AMO surveillance is not clearly specified as a mandatory inspection that must be conducted at least once per year. Additionally, the maintenance organization certification checklist, which covers 88 questions in eight categories of inspection regardless of the scope and field of AMO inspection, was applied equally to all AMO inspection activities, whereas the leading aviation countries are either operating or preparing a checklist that can specifically identify the vulnerable areas of an AMO and facilitate an intensive inspection.

Table 14 AMO Surveillance System Comparison

Type	Training Program	Note
ICAO	- Minimum one year of inspection frequency - Regular and irregular inspections	Scale of aviation industry considered
FAA	- Risk-based inspection system - Categorized inspection items - Scope/frequency of inspection based on analysis and evaluation	Minimum one inspection every year for foreign AMO
EASA	- Inspection every 24 months to determine whether AMO requirements are met - Risk-based inspection system planned to be adopted	Minimum one inspection every year for foreign AMO
South Korea	- Inspection frequency is not clearly specified - Single checklist applied to satisfy AMO requirements	No standard for foreign AMO inspection

6. Improvement Plan for Domestic System

Based on the differences identified through the comparative analysis, the following measures for an enhanced domestic AMO certification and surveillance system are proposed to improve the domestic AMO surveillance system and proactively respond to the ICAO AMO global recognition system.

6.1 Requirements of Aviation Safety Inspector (Airworthiness Inspector)

AMOs should be added as an inspection subject in the duties of airworthiness inspectors targeting international, domestic, and small air transport operators, aircraft operators, and private aircraft owners, and the qualification and experience

requirements for AMO airworthiness inspectors should be revised accordingly. The Air Safety Inspector's Administrative Rules provide the basis for an airworthiness inspector to conduct AMO certification and inspection activities under Articles 97 and 132 of the Aviation Safety Act, but the qualification and experience requirements of airworthiness inspectors based on the inspection subject do not address AMOs. Therefore, the revisions shown in Table 15 are proposed for Article 5(qualification and experience of inspector), Annex 1(qualification and experience requirements of inspector) based on the consultation with ICAO's guidelines and the systems used in the leading aviation countries. Requirement revision should be combined with a human resources policy for utilizing expert personnel for AMO certification and surveillance to maximize the effectiveness of the revised requirements. Currently, most contract officers for air safety and aviation inspection belong to the Ministry of Land, Infrastructure and Transport headquarter for the inspection of international air transport operators.

Table 15 Proposed Qualification/Experience Requirements of AMO Inspectors

Type	Experience Requirement	Qualification Requirement
Maintenance organization certificate holder	5 or more years of work experience in aviation maintenance field	Proof of aviation maintenance technician license

This promotes inspection efficiency by having personnel with at least five years of work experience in the air transport business. S. J. Choi insisted on the nation's efforts to bring the AMO certification process to international standards as a way to foster the domestic MRO industry [17]. The employment of personnel with work experience in AMOs or aircraft maintenance facilities for AMO certification and surveillance will aid in enhancing the level of the domestic AMOs.

6.2 Specialized Training Program

As previously discussed, the ICAO guideline recommends the completion of a specialized curriculum necessary to perform inspection duties. However, there is no specialized training curriculum for AMO certification and surveillance as part of the current training programs for airworthiness inspectors in South Korea. Regulations for domestic AMOs have been modeled on those of leading aviation countries. Likewise, it is possible to develop a curriculum tailored to South Korea based on the specialty training programs in leading aviation countries. The developed curriculum should be specified as a requirement for the airworthiness inspectors responsible for AMOs in the future. Y. S. Choi argued that ICAO's role in the AMO global recognition system will be limited to encouraging the implementation of the system as a facilitator and that a regulatory system, the FAA Aviation Safety Agreement for example, and the ability to implement it are important in the AMO global recognition system[2]. The development of a specialized AMO training course will not only strengthen the expertise of airworthiness inspectors but also help inspectors prove their inspection capability within the ICAO AMO global recognition system. Moreover, the development of a specialized curriculum should be accompanied by the operation of a training institute that can effectively and systematically implement the curriculum. Therefore, the addition of a specialized AMO training curriculum should be considered for the training program at the government-affiliated Korea Aviation Academy being established under the Third Aviation Policy Master Plan announced by the Ministry of Land, Infrastructure and Transport in December 2019[18].

6.3 Effective Surveillance System

It was possible to confirm that the AMO inspection was not clearly linked to the domestic aviation safety inspection system. The following improvement measures are proposed to enable the integrated operation of the AMO inspection system in the aviation safety inspection system.

6.3.1 Classification of AMO Certification and Surveillance

Article 9(Duties of Inspector) of the Aviation

Safety Inspector's Administrative Rules stipulates that safety activities for air operator certificate holders should be conducted following the Aviation Safety Inspector's Manual, whereas the standards or basis for AMOs are not included in the Aviation Safety Inspector's Administrative Rules. Moreover, while Article 2 (5) of the Aviation Safety Inspector's Administrative Rules provides inspection fields and checklists required for aviation safety inspection duties and stipulates that an aviation safety inspector conduct inspections accordingly, the Aviation Safety Inspector's Manual consists only of procedures and checklists for approval, permission, checks, surveillance, and inspection of air operator certificate holders. Therefore, revisions to the policy regulations are proposed to reflect the integration of the current AMO inspection in the national aviation safety inspection system; these revisions are outlined in Table 16. The aim of these revisions is to reflect AMO inspection policy in the aviation safety inspection system, revise details relevant to AMOs in the Aviation Safety Inspector's Manual, Vol. 4 on the duties of Regional Aviation Offices, and apply the Assessment Guideline for Maintenance Organization Certification in AMO certification.

Table 16 Proposed Revision of Rules Related to AMO Surveillance System

Type	Requirements
Aviation Safety Inspector's Administrative Rules (Directive)	Clarification of administrative rules applicable to AMO certification and inspection - Amendment of rules such that the certification duties for AMOs correspond to the Assessment Guideline for Maintenance Organization Certification and the inspection activates for AMOs are conducted according to the Aviation Safety Inspector's Manual
Aviation Safety Inspector's Manual (Guideline)	Reflection of inspection area, procedure, and checklist - Addition of relevant details in Volume 4, "Checklists for Regional Offices of Aviaiton"
Audit Guideline for Maintenance Organization (Directive)	- Restriction of the application as a policy regulation for maintenance organization certification - Revisions such that inspection activities comply with the Aviation Safety Inspector's Administrative Rules and Manual

6.3.2 Segmentation of AMO Surveillance Checklist

The current AMO surveillance checklist applies equally to all AMOs regardless of their inspection results, quality level, and scale. In the FAA, risk-based inspection activities are performed by segmenting the checklist to collect detailed information on specific AMOs and evaluate them through the respective system. EASA is also in the process of revising the regulations to establish a similar system. The risk-based inspection system has the advantage of being able to determine the frequency and area of inspection based on the characteristics and level of the subject AMO. This system can effectively utilize national resources and enhance the efficiency of inspection activities. In South Korea, the inspection activities for air transport operators are performed by categorizing the inspection items and checklists in detail and reflecting the recurrent inspections under each checklist in the annual plan. In response, J. J. Lim suggested that the FAA SAS should be benchmarked to improve the aviation safety inspection system for domestic air transport operators to resolve the problems in the national management and inspection system from the safety management perspective in the air transport industry[19]. H. M. Joe compared the AMO system in Korea and the U.S. and suggested the following reasons for segmenting the AMO checklist as a way to improve the domestic inspection system. First, the current AMO checklist only confirms the implementation of the requirements and is not suitable for assessing the level and risks of AMOs. Second, it is necessary to standardize the inspection capacity of inspectors because the current checklist provides only the minimum requirements, and it will be difficult to expect

consistent inspection results due to unpredictability and subjective judgments of inspectors with varying competency and perspectives[20]. To be recognized as an international-level AMO inspection system, the shift to a risk-based inspection system is inevitable. In this regard, a detailed checklist that can identify the risks and safety level of AMOs in South Korea should be established based on the risk-based inspection system for AMOs used by leading aviation authorities, such as the FAA, and a system for risk analysis and evaluation through information and data obtained from the checklist is necessary.

7. Conclusion

To proactively respond to the ICAO AMO global recognition system, ICAO's guideline and the systems used in the leading aviation countries were reviewed and compared with the domestic system, and improvement measures were proposed, such as strengthening the expertise of airworthiness inspectors in the domestic AMO certification and surveillance process and improving the inspection system. The ICAO AMO global recognition system poses an important opportunity for South Korea; thus, it is necessary to establish an inspection system that will advance the national regulation system and effectively implement these regulations. Thus far, the development of South Korea's inspection system and the expertise of inspection personnel have emphasized the air transport industry, which has garnered more attention as a key industry. However, it is time to advance the AMO system and grow the MRO industry in accordance with national policy. While the establishment of human and physical infrastructure to foster the MRO industry is important, an internationally trusted and recognized national regulation and inspection system is equally critical.

The advancement of the AMO system in South Korea and international recognition as a leading aviation country will aid in ensuring aviation safety and serve as a steppingstone in developing the MRO industry. It is our expectation that this study will be valuable in advancing the national AMO inspection system.

Epilogue

This study was conducted with research funds provided by the Korea Agency for Infrastructure Technology Advancement under the research project,
"Development of International Certification System and MRO Technology for Aircraft Landing Gear and Winglet Composite" (20ACTP-B147766-03).

References

[1] ARSA (Aeronautical Repair Station Association) Annual Repair Symposium, "AMOs approval and global recognition Status," pp. 6-10, March 2017.

[2] Y. S. Choe, S. K. Lee and C.Y. Lee, "A Study on the Improvement of Regulations for AMO Global Recognition System of International Civil Aviation Organization," Journal of Aerospace System Engineering, vol. 14, no. 3, pp. 32-41, 2020.

[3] Ministry of Land, Transport and Maritime Affairs, Public Notice 2009-1296, "The 1st Aviation Policy Master Plan," December 30, 2009

[4] ICAO Annex 6, Operation of Aircraft, Part I, Chapter 8 (11th edition, July 2018) and Annex 8 Airworthiness of Aircraft, Part II, Chapter 6 (12th edition, July 2018).

[5] ICAO Doc. 8335, Manual of Procedures for Operations Inspection, Certification and Continued Surveillance (5th edition, 2010) and ICAO Doc. 9760, Airworthiness Manual (3rd edition, 2014).

[6] ICAO QRG, "Oversight of Approved Maintenance Organizations (AMOs) or organizations performing maintenance under an accepted equivalent system," May 2020.

[7] U.S. Office of Personnel Management, http://www.opm.gov.

[8] FAA Academy, Course 21058-Certfication and Surveillance of Part 145 Repair Stations, https://www.academy.jccbi.gov.

[9] FAA Order 8900.1, Flight Standards Information Management System (FSIMS), https://fsims.faa.gov.

[10] U.S. Code Title 49 U.S. Code Title 49, § 44733. "Inspection of repair stations located outside the United States," https://uscode.house.gov.

[11] EASA Regulation (EU) No. 1321/2014, Continuing

Airworthiness, Annex 2 (Part-145), 145.B.30, June 2020.
[12] JAA Training Organisation, https://jaato.com.
[13] EASA, UG.CAO.00006-007, Foreign Part-145 approvals-User Guide for Applicants and Approval Holder, May 3, 2020.
[14] EASA Notice of Proposed Amendment 2019-05(C), Embodiment of safety management system (SMS) requirements into Part-145 and Part-21, April 2019.
[15] Aviation Safety Act, http://www.law.go.kr.
[16] Ministry of Land, Infrastructure and Transport, Directive no. 1147, January 2019.
[17] S. J. Choi, "A Study on Aviation MRO Industries and Growth Strategy in Korean MRO," Journal of the Aviation Management Society of Korea, vol. 15, no. 2, pp. 3-19, April 2017.
[18] Ministry of Land, Infrastructure and Transport, Public Notice 2019-1000, "The 3rd Aviation Policy Master Plan," December 31, 2019.
[19] J. J. Im, J. H. Han and H. C. Lee, "Improvement of Safety Management System in Air Transportation Industry," Journal of the Aviation Management Society of Korea, vol. 13, no. 6, pp. 55-76, December. 2015.
[20] H. M. Joe, "Comparison of AMO System between Korea and US," Journal of Aerospace System Engineering, vol. 10, no. 2, pp. 27-33, 2016.