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A Study on the Outsourcing of Aircraft Maintenance Contracts

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Abstract

With the exception of some large domestic airlines with adequate maintenance capability, most low-cost and small airlines do not have the facilities, equipment/tools, or manpower to perform periodic inspections over "C check." They are repaired according to maintenance programs specified by manufacturers. The outsourcing (domestic or overseas) of maintenance contracts is thus crucial to achieve good quality service at low cost, and these contracts therefore need to be signed with a full understanding of what is to be expected. This study aims to determine the requirements to be considered prior to finalizing such contracts.

Key Words: MRO, Maintenance, HMV (Heavy Maintenance Visit), Airworthiness, AMO, IATA, ICAO

1. Introduction

As of 2021, there are a total of 11 registered airlines in South Korea, including two full service carrier airlines. However, in addition to some major airlines equipped with in-house capabilities for heavy maintenance, most domestic airlines do not possess heavy maintenance capabilities other than line maintenance. Most airlines tend to outsource maintenance services to domestic or foreign aircraft maintenance, repair, and overhaul (MRO) organizations, and there has been growing emphasis on the importance of outsourcing maintenance contracts [1]. To ensure the airworthiness of an aircraft, an airline must perform maintenance for specified maintenance tasks within a given time period according to the inspection period recommended by maintenance planning data or documents (MPD) of the aircraft manufacturer. This ensures the management of the aircraft's continued airworthiness and is also a prerequisite for operating an airline business. Therefore, if an airline is not equipped with its own capabilities for heavy maintenance, it is necessary to have maintenance contracts with domestic and foreign MROs that are approved by the Ministry of Land, Infrastructure, and Transport to ensure the maintenances task within the specified period [2].

However, to ensure that MROs perform contracted maintenance, preparation and verification are required over a considerable amount of time to meet specific requirements, such as the need to have a limited rating for the applicable aircraft on the operation specification. Domestic and overseas MROs need to acquire certification from the Approved Maintenance Organization (AMO) from the Ministry of Land, Infrastructure, and Transport before being authorized to sign maintenance contracts. In addition, for registrations of limited rating on operation specification during the preliminary review by the Ministry of Land, Infrastructure, and Transport, an MRO should be approved with their Approved Maintenance Organization Procedure Manual (AMOPM) complying with complex processes and requirements, such as the equipment/tool for the applicable aircraft model, documents/facilities, and the maintenance personnel who are certified for the applicable model. In the case of domestic MROs, the AMOPM is relatively easy to obtain, whereas in the case of overseas MROs, the manual that is adequate for acquiring the AMO certification from the Ministry of Land, Infrastructure, and Transport is not easy to develop and establish. Further, overseas MROs find it challenging to secure a review slot for the approval, which takes a considerable amount of time.

For most domestic airlines that do not have in-house heavy maintenance capabilities, their level of expertise in outsourced maintenance contracts is low, potentially leading to unfavorable provisions in contracts owing to a lack of understanding about these provisions, problems handling disputes with the cost-bearing entity during maintenance, and the consequent over-expenditure in the maintenance cost and compromised quality. Therefore, in this study, we propose an effective method for realizing the successful acceptance of high-quality aircraft through cost-efficient maintenance by performing a thorough analysis of various risk factors that are implied in the initial proposal provided by the MRO, and this is required prior to signing of contracts for outsourced heavy maintenance.

2. Basic composition of outsourcing maintenance contracts

2.1 Classification of maintenance tasks and skills

It is necessary to review the adequacy of the content of the

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contract and to understand the basic terms used in maintenance and contracts to execute this specific contract. Typically, contracted heavy maintenance visit includes assessing the upcoming tasks equivalent to a "C" check or above, but specific details can be included in the work package of the operator according to the list of maintenance tasks and skills presented in Tables 1 and 2.

Table 1 Classification of Tasks [3]

Check Type	Maintenance Task
Line Maintenance	Pre/Post
	A Check
	B Check
	Calendar Check
Heavy Maintenance	C Check
	D Check
Component Maintenance	Bench Check
	Repair
	Overhaul
Additional Maintenance	A.D/S.B

Table 2 Classification of Skills [3]

Skills	Tasks	Remark
APG	On-site maintenance	Including cabin maintenance
SMT	On-site maintenance	Sheet metal
Avionics	On-site maintenance	Electric and electronic
Equipment maintenance	On-site maintenance	Shop maintenance
NDT	Non-destructive testing	
Engineering	Technology	Technical review
Quality	Quality	Quality inspection/assurance

2.2 Main composition of an outsourcing aircraft maintenance contract and related work flows

In most cases involving contracted maintenance, the MRO provides the initial proposal. The respective clauses of the contract presented below are reviewed based on the International Air Transport Association (IATA) Document No. published by the IATA. For critical issues to be considered before signing the contract, detailed information for review is included in each relevant clause [4]. For a comprehensive understanding of the overall work flow in the contract process, a flow chart is presented in Fig. 1.

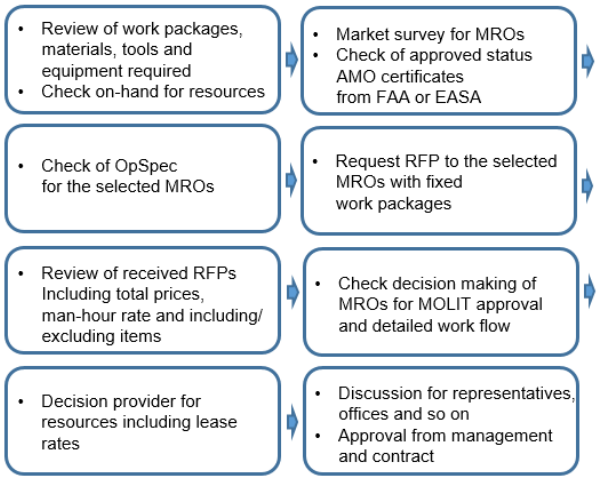

Fig. 1 Work Flow for Maintenance Contract

1) Scope of agreement

General information about the overall content of the contract is described.

2) Definitions and abbreviations

Definitions and abbreviations of terms described in the contract are provided.

3) Delivery, turnaround time, and return

This clause describes the receiving/delivery of the aircraft and the maintenance period, and detailed descriptions are often provided in the Annex (also expressed as Appendix or Exhibit).

4) Standards of services

This clause describes the content of the basic services provided by the MRO during the period of the contracted heavy maintenance. If this clause is not properly reviewed, disputes may develop during maintenance, and costly damage with additional expenditure may arise. Therefore, this clause should be thoroughly reviewed. If it is stated in the clause that a cleaning service is included, the exact scope of the cleaning service should be specified [5]. In addition, the clause should include serviceable parts, such as removable or replacement parts, unserviceable parts, and separation of scrapped parts. This content is essential for ensuring the quality of the aircraft. Further, adequate calibration of the precision measurement equipment (PME) to be used is required, and equipment used in the maintenance should be recorded. When the maintenance document is written in the native language of the MRO, all maintenance documents must be retranslated in English in the event of the aircraft's future rental or sale. Therefore, the clause should specify that all maintenance records should be written in English, which is the international standard language. In addition, the method of handling the residual fuel must be specified during receipt of the aircraft, and the method of re-fueling at delivery should be included to reduce the likelihood of disputes subsequently [6]. In the case of some small MROs, they insist on the disposal of the residual fuel because they have no adequate storage facility for the fuel.

5) Airworthiness data

A tally sheet, which is a list of maintenance tasks to be conducted, and a signed worksheet must be provided. Airworthiness Tags (e.g., FAA 8130-3 or EASA Form 1) and recordings of the flight log are also essential. In the case where the transcription of the flight log has been delegated, preliminary training is required on how to write the log. Further, for the additional delegation of Return to Service (RTS) documents, a careful review is required when checking the necessary qualifications and certificates. In addition, a daily check of the record status of the flight log is required by the onsite personnel of the operator.

6) Material and tool provisioning

Because this clause is the most important part in terms of cost, the operator should review in detail the expected consumption of materials that are required when conducting the tasks included in the outsourcing maintenance contract as well as the list of equipment/tools. The classification of typical materials used in aircraft maintenance is presented in Table 3.

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Table 3 Classification of Materials and Provider

Classification of Materials	Provider
A (Rotable)	Usually provided by the operator
B (Repairable)	
C (Expendable)	MRO Charge Base

The classification of rotable, repairable, and expendable materials is conducted according to the operator's asset management criteria. To comply with the specified maintenance period, the setting of boundaries of responsibilities provided by the operator and MRO is a highly sensitive issue, and in usual practice, the materials of the "A" and "B" classes are provided by the operator. In general, it is important to determine the period for the completion of the initial inspection task of an aircraft. As the completion of the initial inspection task is delayed, the potential for the transfer of the responsibility increases as the deadline for material provision of the operator is tight, leading to increased stress throughout the entire process. Therefore, it is advantageous for the operator to specify in the contract that the initial inspection task should be completed within about 30% of the entire process so that all defects can be identified and corrected. A careful review is necessary to minimize the risks according to the material provision responsibility by clarifying the deadline for completing the initial inspection task. If the completion time of the inspection task is delayed, it leads to inevitable delay in the subsequent repair or exchange tasks, thus affecting the delivery time.

For Class "C" materials, the common practice is for the MRO to purchase the materials and charge a handling charge (typically about 15% of the cost of materials). Therefore, a list of Class "C" materials used (non-routine card number, part number, description, quantity, unit price, total price, etc.) should be stipulated for a detailed review by the on-site personnel of the operator. This could serve as an effective method of saving the cost. In particular, the availability of Parts Manufacture Approval (PMA) parts must be specified. In the case of PMA parts, because they are not listed in the manual of the aircraft manufacturer, these parts are more difficult to repair, and unless there was a process in place such as preliminary review, the reliability of the parts cannot be guaranteed, which may lead to various problems. This is also the information that must be specified in the sale of the aircraft, and thus special attention is required on this matter [7]. It should also be specified that materials scrapped by the MRO during maintenance need to be stored in a separate storage container along with the list of other materials. Furthermore, it should be stated that the materials should be stored until the operator decides on the scrapping of the materials (to prevent the reuse of scrapped materials and reduce costs).

Table 4 Classification of Tools and Equipment and Provider

Tool Category	Provider
Common/General	MRO
Special	Operator

Table 4 presents the classification of equipment and tools used in the maintenance contract. A general tool refers to a tool commonly used for all aircraft models, is often provided by the MRO, and is included in the firm fixed price (FFP). Further, a common case is that operators provide special tools used only for the applicable aircraft. In general, by reviewing in advance the list of required special tools according to the type of heavy maintenance inspection, and by classifying the tools that are possessed by the operator, the operator should determine/secure in advance the purchase or rental of special tools that are not in stock.

7) Rates and charges

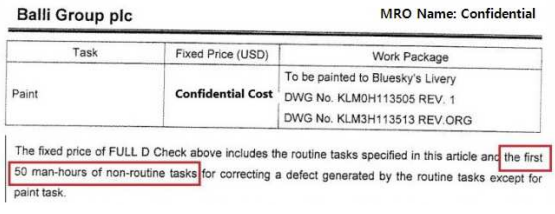
This clause describes the rates and charges of the outsourcing aircraft maintenance contract of domestic airlines, which is classified as confidential based on the practical experience. The target airlines and MRO include Korean Air, Hi Air, United Airlines, ATR, Boeing, GECAS, and TAECO, among others. This clause can be stipulated by moving the clause to the Annex and is a key factor in determining the cost of contracted maintenance. The rates for each skill are often specified and are applied when additional work is required. Most of the other costs are categorized as FFP and time and material prices (T&M). In the majority of cases, an airline receives the proposals from 2–3 MROs when reviewing the outsourced maintenance contract, and there are many cases in which the airlines only concentrate on FFP and select the MRO with the lowest proposed FFP. In the case of FFP, it is advisable for the operator to compare the total man-hours presented by the MRO with the data used to calculate the standard man-hours for the maintenance tasks that are included before signing the contract. With

respect to the man-hours according to the maintenance tasks, the MPD provided by the manufacturer can be utilized. However, the actual required man-hours may differ from the man-hours provided in the MPD, and the operators should perform a review based on their own standards.

Table 5 Sample Contract Content of Non-routine Labor Ratio Between the Operator and the MRO

Non-routine labor ratio	USD
A/C technician	56.21
Back shop technician	60.03
A/C cleaner / painter	43.66
Engineering service	103.95
Inspector	72.77
ATEC 5000 / IRIS 2000	109.73

Table 5 outlines the man-hour rates per skill specified in the contract between a domestic MRO and a foreign airline (Operator). It is necessary to check the excessive engineering service, inspector, and non-destructive testing (NDT) when compared with the man-hour rate required for on-site maintenance. For MROs located in Southeast Asia, the current on-site labor cost is about $60–$70, and for engineering, an inspector, and NDT, there are many cases when the rate exceeds $100. Therefore, it is advisable to verify whether these high rates for these works are justifiable compared with the rate for performing on-site maintenance. For the engineering review, it is possible to specify a cap of the required man-hours per non-routine case or to define the man-hour rate in clause 4) Standards of services with the inclusion of engineering service. Typically, when the number of man-hours for repair per non-routine case is specified as 50 man-hours, there would be no cases that incur an additional cost, except for the specified cost. In the case of correcting unscheduled non-routine defects that are identified in the routine inspection, it is advantageous for the operator to include these cases to some extent to FFP. In a usual contract, the man-hours for correcting the defects per non-routine case are calculated as 25, 50, or 100 man-hours. Considering that FFP increases as the ratio of this item increases, the condition of the operator's aircraft to undergo maintenance should be considered in detail. A case of specifying the non-routine labor cap in the clause of a maintenance contract between a domestic MRO and European operator is presented in Fig. 2


Balli Group plc MRO Name: Confidential

Task	Fixed Price (USD)	Work Package
Paint	Confidential Cost	To be painted to Bluesky's Livery DWG No. KLM0H113505 REV. 1 DWG No. KLM3H113513 REV.ORG

The fixed price of FULL D Check above includes the routine tasks specified in this article and the first 50 man-hours of non-routine tasks for correcting a defect generated by the routine tasks except for paint task.

Fig. 2 Contract Sample Page for Non-routine Labor Cap

In particular, because small airlines often do not have accurate data on man-hours of unscheduled maintenance compared to scheduled maintenance, a careful review is required in this regard. It is essential to check the details of how much repair time that has taken a considerable time compared with the required scheduled maintenance time during the usual line maintenance. In addition, if it is possible to obtain from the manufacturer data such as the rate of occurrence of non-routine defects according to the number of years of service of the aircraft, which is then reviewed in advance, this will help in terms of a more efficient process of the contract execution.

8) Warranty

In this clause, the warranty period is specified to be earlier than the usual period or flight hours, and from the perspective of the operator, the longer the warranty period, the more advantageous. In general practice, the warranty period is determined to be the earlier than 1 year or the annual average FH.

9) Invoicing and payment

In this clause, the payment method is specified, and the payment is categorized as down payment and balance. In principle, all should be paid before the delivery. The extra costs that were also approved on site, such as material, non-routine correction, and fuel costs, are approved by the operator in advance and invoiced.

10) Liability

This clause describes the limits of liability for possible events and is written in accordance with the conventional practice.

11) Insurance

This clause describes the contents of the insurance to which the operator and the MRO must subscribe for possible events, and it is written according to the general practice.

12) Flight test

This clause is applicable in the event of a defect that requires a test flight during inspection, and the cost breakdown should be specified in the Annex of the contract in advance. The entity for bearing all expenses, such as flight crews and required fuel costs, should be determined as well.

13) Delay

This clause describes the compensation for delay when the contracted turn-around time (TAT) has not been met, and it is written based on conventional practice.

14) Subcontracted work

A case of subcontracted work occurs when the MRO cannot perform maintenance on its own and uses the MRO's subcontractor to perform the maintenance. If subcontracted maintenance is performed, the subcontractor's operating rules and procedures should be reviewed prior to execution of the contract to ensure their adequacy.

15) Duration/Termination of agreement

This clause describes the details related to the

continuation or termination of the contract.

16) Governing law and arbitration

This clause includes matters related to legal actions in the event of a dispute during the term of the contract.

17) On-site personnel

In this clause, items that are required when on-site personnel of the operator are present are specified, and information such as the office size according to the number of personnel, computers, printers, copiers, and communication facilities is included. This is typically included in FFP, and the onsite personnel comprises the technical representative, personnel for production, engineering, materials, and an inspector. However, depending on the competence of the technical representative, only the technical representative and the inspector may be required to form the on-site personnel team.

The on-site personnel must obtain the MRO's AMOPM or the repair station/quality control manual (RSM/QCM) from the airworthiness authority and ensure whether the procedure of the conducted work complies with the specifications in the manual. For all tasks performed by the MRO during the period of the contracted maintenance, the daily status, including the work tasks and non-routine correction, should be recorded and provided. It should also be specified that the progress of the work and the problems should be monitored through daily meetings.

18) Quality and safety audits

In this clause, it should be specified that an audit can be conducted whenever required by the operator or the competent airworthiness authority of the operator. If there is a deviation by the MRO from the matters specified in the AMOPM, a special audit may be conducted. If possible, the audit should be conducted on a daily or at least weekly basis to prevent quality degradation resulting from nonconformity. In particular, when outsourcing the inspection of required inspection items (RIIs), it is possible for the operator to directly perform the training for the RII inspector of the MRO or to deliver the content of the training to the trainer in the maintenance training center of the MRO. When performing training, the necessary qualifications must be checked in advance, and a delegation letter should be issued after the training.

19) Annex (Appendix)

When receiving the initial proposal, the operator must check the MRO's Part 145, Repair Station Certificate (including limited rating) for the required certificate of the airworthiness authority. The Annex should also include the work scope and package, delivery/return date, acceptance certificates, certificate of release to service, and a list of documentation.

3. Conclusion

In this study, important issues that must be considered for the contract and the contents that must be prepared in advance were investigated based on the basic process of executing the MRO maintenance contract proposed by the IATA. After reviewing in detail the items not included in the total cost proposed by MRO for the work package reviewed by the operator, a case-by-case discussion is required. In addition, the status of the stock of materials, equipment, and tools and plans to acquire these items should be determined in advance so that the cost on rented items should be discussed with the MRO prior to receipt. In addition, to prevent the incurring of unexpected costs, the basic number of man-hours, which includes the non-routine labor ratio, should be specified in the contract clause. The contract presented by the IATA is a recommendation, and from the experience of the author having executed maintenance contracts with various MRO organizations and working on heavy maintenance (including modification) as a program manager, most of the outsourced maintenance contracts contain clauses that are similar to the provisions in the basic contract presented by the IATA. Therefore, an in-depth preliminary review is required for each item as well as the classification and analysis of aircraft maintenance data of the operator (number of man-hours, materials, equipment, and tools) at least 6 months prior to the start of the contracted maintenance, and this would serve as a shortcut to executing contracts that are advantageous to operators.

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