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Technology Transfer Challenges in Indonesia: An Experience from Industry Turbine Overhaul

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ABSTRACT

This paper discusses the problems and challenges that Indonesia faces in the process of its technology transfer. Matters discussed in this paper are based on the lead writer's personal observation and experience of the technology transfer taking place in Indonesia's turbine maintenance and overhaul industry.

The first challenge faced is the lack of basic skills on the part of factory workers. The next challenge is the lack of supporting industries. Furthermore, the low level of English proficiency of the workforce has contribution to the technology transfer problems. Final challenges are the low credibility of the government entities that oversee the turbine maintenance industry in Indonesia. The steps undertaken in the technology transfer in the turbine maintenance and overhaul industry in Indonesia is done through several complex stages.

Keywords: challenges in the transfer of technology, technology transfer in Indonesia, turbine maintenance and overhaul industry.

1. Introduction

In 1984, General Electric won the tender competition of aircraft turbine election (GE CT7) for new CN 235 aircraft designed jointly by the PT Nusantara Aircraft Industry (a state owned company) from Indonesia and CASA of Spain. As part of the agreement, General Electric shall establish facilities Turbine Overhaul of Aircraft in Indonesia as well as carrying out the process of technology transfer so that the facility is fully functional, according to the standards set by the factory and run by local personnel.

Keep in mind at that time there has been no overhaul facility turbine aircraft operating in Indonesia, except commercial facilities owned Garuda Indonesia (Indonesian flag carrier). Facilities owned by Garuda Indonesia at that time are only to serve the needs of internally, so that the operators must send their engine abroad for overhaul maintenance.

Step PT Nusantara Aircraft Industry that would build a turbine maintenance overhaul that includes the ability to turbines aircraft commonly used in Indonesia as it is a strategic step in building the capability within the country, so the flight operators no longer need to send overseas turbine besides course to

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prepare the product support for the CN-235 aircraft.

After solving various problems and challenges, the process of building the turbine aircraft overhaul facilities and transfer of technology / skills to local workers had successfully done. This paper finally discusses the problems and challenges that Indonesia faces in the process of its technology transfer. Matters discussed in this paper is based on the lead writer's personal observation and experience of the technology transfer taking place in Indonesia's turbine maintenance and overhaul industry.

2. Turbines Overhaul Processes

Turbine motor used for aircraft power consisting of various static and rotating components that have different thermal cycle according to usage in aircraft. The various components of the turbine after use for some time will experience damage (corrosion, wear and tear).

Turbine manufacturers have made many good maintenance schedule and the level of light weight (overhaul) to ensure performance in accordance with the standard turbine feasibility of flying and flight safety (airworthy and water safety). Timed in light treatment can be done without removing the motor from the wing turbine aircraft (on wing maintenance). Treatment weight (overhaul) is done by sending a turbine motor to an overhaul facility that has been in the factory authorization.

An overhaul facility turbine aircraft must obtain authorization from the manufacturer (OEM authorization) and the state air agencies local fitness (Airworthiness authority). To obtain authorization, a turbine overhaul facilities must have a complete tool, skills / competencies that both of the employees, adequate shop operation procedures, and spare part supplies a complete and adequate. From time to time overhaul facility will be audited by the factory inspector and Airworthiness authority to determine whether the facility can operate either to provide flight safety guarantee. When the overhaul facility can not demonstrate a good standard of operation, the Airworthiness Authority may revoke the approval of the garage because it was considered would endanger flight safety.

Overhaul process at a treatment center are steps taken to ensure the performance of new turbines to be like again. Basically, the steps performed in an overhaul process are as follows:

Receiving Inspection: the process of initial inspection of the turbine is sent to the workshop. In this process will only be seen visually, checking the completeness of components or record things that are not normal (the signs of corrosion, overheat, foreign object damage / FOD, etc.).

Disassembly: the process of dismantling the turbine up to the smallest form. The whole part of this turbine will be inspected one by one in accordance with the turbine manual.

Cleaning: all turbine components will be cleaned so as to facilitate inspection process. This cleaning process is done or the mechanical and chemical.

Inspection: all components of the turbine will be checked to ensure the condition. This inspection process is the heart of the turbine overhaul process. All turbine parts will be grouped into three namely: scrap (can not be used again), repairable (to repair), and serviceable (can be used again). Error in determining the condition of this part can be fatal where the turbine does not operate optimally or even fail to operate. Various sophisticated inspection techniques used in this process include: visual inspection, dimensional inspection, non destructive inspection to determine crack (may use Fluorescent Penetrant inspection, magnetic particle inspection, x-ray, eddy current inspection etc).

Repair / refurbishment: All components of the entry categories will be repairable refurbishment process to restore the initial conditions. Various sophisticated repair techniques performed here by using processes such as machining (conventional and inconventional), the coating material (all kind of welding and plasma spraying), the process of heat treatment, shot peening, corrossion treatment and coatings, chemical plating. The more complete the repair process has the overhaul facility will be more able to reduce the cost of increasing the competitive overhaul advantage. Various techniques refurbishment of turbine parts can be independently developed by the overhaul facility, so that some parts are in scrap condition can be returned in accordance with repair technological developments owned.

Accumulation / Kitting: In this process the process of completing all turbine parts that should be done there. Parts are in the scrap replaced with new spare parts. Repairable parts will be used again after completing the necessary repair. The serviceable used parts will surely again. The kitter will make sure that all parts are complete for reassembly.

Assembly: All parts that have been checked in the process of accumulation trimmings will be sent to the assembly and the turbine assembly whole again. Assembly process also involves activities requiring precision and accuracy.

Performance Test: After the assembly, the turbine is sent to the testing center (engine test cell) to test its performance. Performance test results compared with reference data that must be achieved so that the engine passed the test and ready to operate in accordance with factory standards.

Shipping: Engine after passed the certification test will be airworthy and ready to be sent back to the customer.

From the above processes it seems that the overhaul process is complex, involving many high-tech processes, requires high competence of its employees, and became one of the factors to ensure flight safety.

3. Technology Transfer Challenges

Lead writer were recruited as one of the trainees that will be employed in the overhaul shop. He had the opportunity to observe the whole process of the development of the overhaul shop and was involved in the technology transfer processes to develop the local talent capabilities. The technology transfer was not easy back then and had to overcome several challenges.

The first challenge faced is the lack of basic skills on the part of overhaul shop workers. Education in Indonesia does not emphasized vocational training, which is a critical requirement in industry. Generally, the output produced by the education institution (namely STM and SMA) is not ready for use by the industry. Often the industry must create its own vocational/practical training to meet their own needs. As you have read above, the industry needs certain specific skills such as: disassembly/assembly, chemical cleaning and plating, inspection (visual, dimensional, non destructive inspection), machining (conventional and inconventional), welding and plasma spraying, and special processes (heat treatment, coating, painting, and shot peening). The Overhaul Shop has to develop its own training center in order to provide basic skills to its workers, technical high school graduates, and requires at least 18 month apprenticeship training before the workers are ready for the real job.

Another challenge is cultural in nature. A technology based industry requires certain attributes such as : planning ahead, the timeliness/punctuality, accuracy, and compliance. Unfortunately, these attributes are not widely practiced in the society. Back then, it required a special effort for emphasizing these attributes to all workers. There were

many findings during early year operation which were due to repeated inaccuracies and incompliance by its workers.

A third challenge is the lack of supporting industries. Often times small and medium industries have to build the whole capabilities from A to Z because of the absence of other small scale industries needed to support it. Ideally the overhaul shop concentrated on the basic overhaul processes such as: receiving inspection, disassembly, cleaning, inspection, accumulation, assembly, and performance test. The repair process of the repairable parts should be contracted out to the supporting industries nearby. Since the whole processes had to be developed by the overhaul shop, some processes do not achieve economies of scale; this will ultimately reduce the competitiveness of the industry. Back then, the supporting industries were only available overseas mainly in Europe and United States of America.

The fourth challenge is the low level of English proficiency of its workforce. Most sources of technology come from Western countries, and utilization of resources such as shop operation manual, engineering/technical documentation, and communications with technology licensors require a basic mastery of the English language.. Technical high school and senior high school graduates spend at least 6 years in studying English, but in our experience this is inadequate due to ineffective way of teaching method. Unlike the neighboring countries such as : Singapore, Malaysia, and Philippines, the English language is not widely used in the daily life in Indonesia. The lack of language skill hinders the technology transfer process.

Last but not least is the low credibility of the government entities which oversees the turbine maintenance industry in Indonesia. Foreign customers are not satisfied with local airworthiness certification. Eventually the local overhaul shop will seek additional certifications from the foreign authorities such as FAA (Federal Aviation Administration of USA) and/or EASA (European Aviation Safety Agency). It requires a regular audit from FAA or EASA to maintain the overhaul shop authorization which was costly and needed a great deal of effort.

Technology transfer in the turbine maintenance and overhaul industry in Indonesia occurs in stages. The technology licensor in the case we study is General Electric and the recipient of the technology (technology licensee) is Universal Maintenance Center (UMC), a workshop owned by PT Dirgantara Industries (previously known as PT Industri Pesawat Terbang Nusantara, The Indonesian Aircraft Industry). The first step begins with the recruitment of a number of technical high school, senior high school, and university graduates. High school graduates are given basic apprentice training that lasts approximately 1.5 years. University graduates are given basic management training that lasts 6 months. The second step is on the job training in a work shop owned by General Electric with assignments based on job title and specialization. The On the job training (OJT) is conducted for approximately 6 month for both technical and managerial work. After completion of the OJT, the workforce is considered ready to work with closely supervision. The following step is what it is called " shadow management", in which workers shadow technical assistants from the licensor. After certain time based on the comprehensive evaluation of the licensor's technical assistant, the trainees and technical assistants will switch roles. The Indonesian worker then perform their full duties assisted by the licensor's technical personal when needed. After some time, the technology transfer process is considered complete and the operation of this overhaul shop can be carried out by the Indonesian worker only with limited assistance from the licensor. In the turbine overhaul industry, the whole process of technology transfer was completed in approximately 30 – 36 months.

4. Conclusions

We need technology transfer in developing the domestic capabilities. Based on the experience in doing technology transfer in turbine overhaul industry in Indonesia, there are several challenges that can impact the process of technology transfer. Such challenges worth considerations are lack of basic skills, requirements of certain attributes, lack of supporting industries, requirements for English language mastery, and low credibility of the authority who oversees the industry.

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