GROSTLOG 2019
Global Research on Sustainable Transport & Logistics

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

Personnel Competency Development For a Successful Digital Transformation in Aircraft Maintenance, Repair & Overhaul (MRO) Industry - a Conceptual Framework

Idrus Moin[1*], Khir Harun[2], Noraida Rahman[3], Fakhrulnizam Mohammad[4]
[1,2,3,4] Universiti Kuala Lumpur, Malaysian Institute of Aviation Technology
[*]Corresponding author: midrus@unikl.edu.my

Abstract. The introduction of the "connected" aircraft by aviation original equipment manufacturers (OEMs) offer opportunities for airline operators and other aviation industry sectors to improve productivity, reduce maintenance costs, enhance safety and enriched customer experience. This revolutionary opportunity has arisen with the development of digital platforms, ecosystems and software applications enabling greater connectivity and higher mobility in the aviation industry. It is crucial for aviation Maintenance, Repair & Overhaul (MRO) organizations to embark on a digital transformation initiative enabling it to seize and actualize this opportunity to remain relevant. MRO has two contributions significant to the industry. Firstly, aircraft maintenance is an essential part of continuing aircraft airworthiness certification. Without this certification, no commercial flight will be allowed by regulatory authorities of any country. Secondly, aircraft maintenance activities represent a high proportion of the airline operating cost and typically can be as high as 35%. The global MRO expenditure is huge with potential spending of US$110 billion. Asia Pacific region will be the 2nd largest spender amounting to US$23 billion. Among South East Asian nations, Indonesia has the highest demand for MRO services spending US$1.5 billion in 2018.Aircraft maintenance personnel competency development is the strategic pillar that will ensure the success of the digital transformation initiative. This paper aims to establish the competency framework needed to complement this initiative. The method used for this paper is based on literature reviews from journal articles, interviews with subject matter experts and online news related to the keywords and research area.

Keywords: personnel competency development, digital transformation, aircraft maintenance

1. Introduction

IATA 12th Maintenance cost conference [1] informs that there are over twenty-seven (27) thousand aircrafts in the global commercial air transport fleet of which over 72% consist of wide-body and narrow-body aircrafts. Twenty-seven percent (27%) of the aircrafts are in the Asia Pacific region. These aircrafts need maintenance to enable its continuing airworthiness certification valid; without which no commercial flight is permissible. Thus the demand for maintenance support for commercial aviation is expected to have a strong growth.

Commercial airlines either perform in-house maintenance in their approved facilities or subcontract maintenance to third party providers. These facilities are labeled as Maintenance Repair & Overhaul (MRO) organization in the aviation industry. These facilities are approved by respective national aviation regulatory authorities. National authorities adopt and adapt Standards and Recommended Practices of the International Civil Aviation Organization.

The expansion of the maintenance business registers a huge global MRO current expenditure with potential spending of US$110 billion by 2025 [2] Asia Pacific region will be the 2nd largest spender amounting to US$23 billion. Among South East Asian nations, Indonesia has the highest demand for MRO services spending US$1.5 billion in 2018.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

MRO as a sector in the aviation industry is complex as it is highly regulated, capital intensive and dealing with technologically advanced equipment. The challenges of rising costs and intense competition in the industry is compounded by the introduction of new technology aircrafts.

New generation aircraft are technologically sophisticated, has enhanced operational flexibility and generate a tsunami of data. The aircraft itself is a data warehouse with 300,000 parameters [3]. As an example a Boeing 737 engine on a six-hour flight will generate 240 terabyte of data. Not surprising for a mid-size international airline the amount of data generated will exceed the petabyte limit. In the next decade it is projected that new generation aircrafts like 777x, A350 and A330neo will increase the global fleet of these new generation to nearly 19,000 aircrafts [4]. In the next 5 years these new generation aircraft will need maintenance. Its life-limited parts will need replacement with scheduled and unscheduled maintenance visits increased.

Maintenance approach will significantly differ as the multitude of data enable in-depth operational and engineering analysis to be performed and provide new insights as to how to approach maintenance. Airframe maintenance approach will differ as compared to ones applied to older aircrafts as the use of composites, titanium and advanced aluminum alloys in aircraft structures tremendously increase. Likewise, engine maintenance will change as the latest generation engines use advanced materials and complex technologies.

The digital age with its disruptive technologies bring new challenges to aircraft maintenance workforce competency. Upskilling in the areas of knowledge, skill and attitude is imperative. The advent of the new generation aircraft coming in for maintenance services requires new set of competencies that is not just limited to the technical area but includes business processes, strategy and environment.

This paper will identify the competencies needed for this new environment and will outline a framework for the competencies. The scope is limited to the License Aircraft Engineers(LAE) whose role is critical to MRO service delivery in terms of airworthiness requirements. Only this category of employees has the signatory privilege of their license to "release to service" any maintenance work done on the aircraft. Thus the success of MRO digital transformation heavily depends on their competency development.

2. Digital Transformation in MRO

There is an exponential increase of data availability generated by thousands of additional sensors and digital systems in the new generation aircrafts today. The enormous amount and the quality of the data available enables aviation MROs to gain insight to optimize costs, enhanced operational capability and create new and unique customer experience and value proposition. Data is organized to elicit new knowledge necessary for organizations to create innovative ways of working and creating new business models.

The IDC report "Future Scape: Worldwide CIO Agenda 2016 Prediction" stressed that "One-third of the top 20 firms in industry segments will be disrupted by new competitors within 5 years," and that is a matter of "transform or perish".

Original Equipment Manufacturers (OEM) has ownership of most of data generated by aircrafts and its engines. With OEM's new found knowledge in the areas of reliability and maintainability of aircraft and engines, they naturally have an edge over MROs in areas of predictive maintenance and prognostics. Subsequently, they start to explore new business stream related to these areas and increasingly would encroach into the aftermarket maintenance services. This disruption into the traditional MRO business environment is adding to the already competitive pressure for MRO business environment.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

This pressure is further escalated by demand of the Low Cost Carriers (LCC) to pay rock-bottom price for maintenance services of their fleet. MROs in this new environment are pushed to the wall. There is no choice but to change and the only way to survive in this digital economy is to embark on a digital transformation journey. MROs seemed sandwiched in between the demand of the airline and the entrance of the OEM with their new found knowledge of maintenance. The airline has "connected" customers and likewise the OEMs their "connected" aircraft design.

Airline customers now are digitally "connected" with various social media, financial, communications and e-commerce platforms giving them wide choices and bargaining power in air travel. The new generation aircraft designed by OEMs, digitally "connect" aircraft operations from take-off to landing. Boeing has its digital factory named as Digital Transformation Environment (DTE) and Airbus has Quantum. Being OEMs both Boeing and Airbus has the advantage of having ownership of data related to their aircrafts. MROs is disadvantage being unable to obtain a full digital picture of operations unless there is close collaboration between all aviation player in sharing all data to form a data thread that will provide meaningful insight relating to costs optimization, productivity enhancement and service delivery. [5].

Data generated should be in true digital form i e XML and should be usable by both human as well as machine consumption. Machines now has capability to learn as in machine learning-based diagnostics for maintenance health monitoring systems. Many MROs currently operated with legacy systems.

Most digital transformation failed with varying rate of about 60-80% [6]. Digital transformation is not just digitizing document. It should be a profound change in the way the organization go about its business. It should impact change in processes, business models and strategy in the organization by leveraging the multitude of digital technologies available. The immediate beneficiary of a successful digital transformation will be the organization itself but later as the transformation matures, all stakeholders like the government, environment, economy and society be included.

The success of MRO digital transformation depends heavily on its strategic imperatives. Each MRO will have its own unique strategy to differentiate itself from competitors in their digital journey. However, there is a common denominator that is key and that is the human talent that needs to be developed to operationalize the transformation strategy. This framework will highlight the competencies critical for success. It will provide a window of opportunity for understanding the gap in knowledge, skill and attitude required. Developmental efforts such as training and various learning interventions can then be design to close the gap.

3. The Competency Framework – Its Outline

Competency framework identify knowledge, skill and attitude [7]. The outline of the competency framework follows International Civil Aviation Organization (ICAO) course development methodology. However, it is important that the framework should enable the competency elements to execute the strategy of the organization [8]. The framework should be in alignment to the vision and values of the organization. Competency framework provide a means of assessment of developmental needs and performance standards in the organization to ensure success [9].

From our engagement with employees of three MRO organizations in Malaysia, we find current working environment shows a high proportion of experience aviation maintenance personnel are in their late 50's & 60's. Their experience and competencies are gained from working with older generation aircraft types. These group forms the expertise backbone of the

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

organization and represent its crucial success element. This finding is also true for the global MRO landscape [10].

LAE's basic training in Malaysia takes a minimum of five (5) years to be certified; after which an aircraft type training is necessary for the LAE to practice the privileges of the license. Our findings show most LAEs are only confident with taking the lead in making critical operational and technical decisions at least two (2) years after obtaining their first type certification with the particular type aircraft of in-service experience. The range and nature of experience are varied in line and hangar maintenance. Meanwhile, for complex in-service problems LAEs often refer to expert advise from their seniors in the organization.

Our discussion with MRO employees related to understanding the business and business direction of the MRO services and its value proposition got brief attention from Lead LAE and Foreman (senior position in the organization). LAEs show no interest in the financial aspects of the business as they stress that their main focus is ensuring airworthiness at all costs. They put forth argument that business and profitability is the responsibility of the commercial group, not theirs. We also find that LAEs knowledge on business, finance and management lacking. At higher level of their hierarchy, the foreman and superintendent exhibited a fair amount of knowledge in the business of MRO. Foreman and superintendent uses generic financial ratios during the discussions on the business of their organization and showed understanding of financial key performance indicators. Knowledge related to management and leadership is superficial and shallow especially among the LAEs. When discussion revolves around strategy, values and leadership; most LAEs revert to their comfortable domain of technical complexity of aircraft and safety aspects of their responsibilities. They are not comfortable with topics other than regulatory technical requirements and specifications.

We depict our findings of needed LAE competencies in Figure 1.

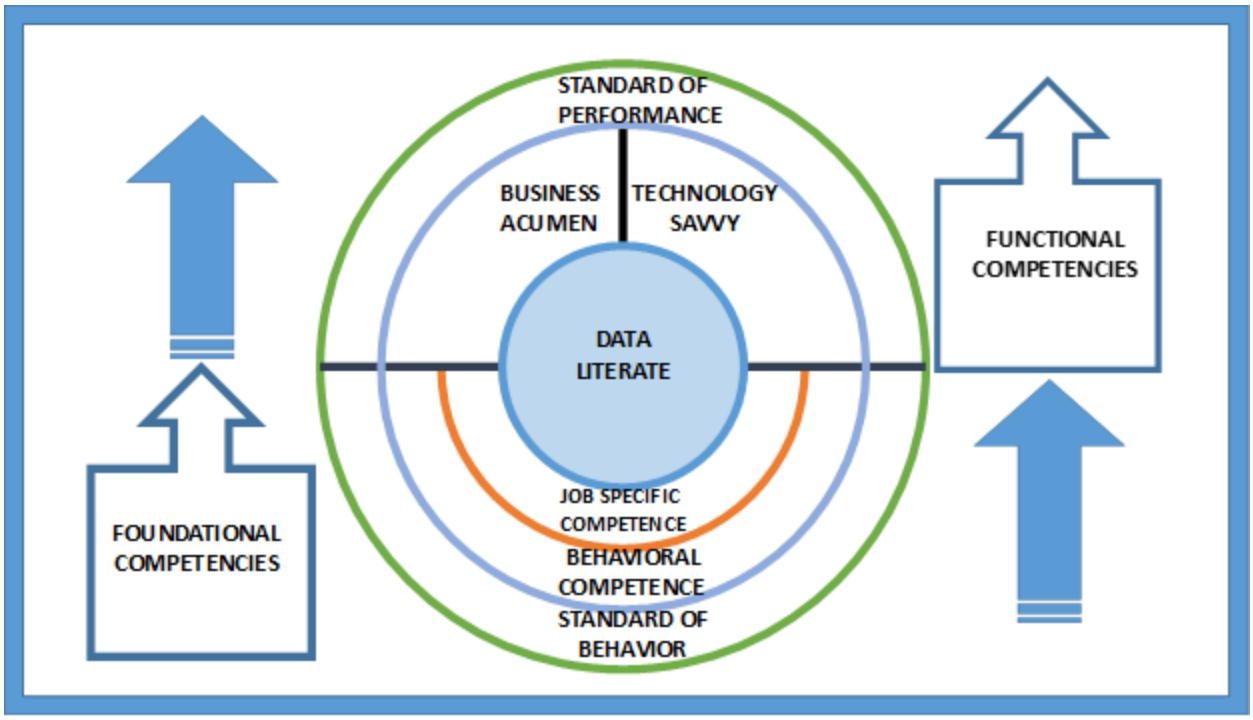

Figure 1. Competency Framework

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

The Competency Framework is outline as Foundational competencies and Functional competencies. Foundational competencies provide the solid base and relates to desired behaviors in innovation, problem-solving & decision making, virtuous values-based behavior and generic job-related attitudes. Functional competencies relate to the requirement of the job roles, responsibility and accountability. Functional competencies deliver the desired result of the job whereas foundational competencies enabled the achievement of the result. The glue that holds and synergizes all the competencies is Data Literacy. Functional competencies are assessed by Standard of Performance and Foundational competencies are assessed by Standard of Behavior. These standards will be defined by each organization and variations between companies may exist but standards should comply to regulatory requirements as the aviation industry is highly regulated.

Elements of the competency framework consist of having/being: -

(i) Business Acumen
(ii) Technology Savvy
(iii) Data Literate

Further explanation of these elements and the need for their inclusion follows.

3.1. Business Acumen

Regulatory requirements for basic training for LAE competency are defined in hours (2400 hours) spend on theoretical and practical teaching and learning. The ratio is often 60% of the former in relation to the latter. The domains of knowledge and skill is always related to technical competency. Very little exposure and in most cases; no emphasis is given to the business areas of MRO. This approach may be relevant for the traditional MRO business where there are layers of technical responsibilities assume by traditional layers of work structures in the form of LAE, Lead LAE, Foreman and Superintendent. Agility in MRO business performance now requires less or no layers of organization structure to improve work processes and deliverables.

Maintenance cost is often cited to be accounting for 10-20 of aircraft related operating costs [11] This would be a major differentiator if the LAE understand all the cost implications of his work and strives to reduce this to a minimum. Exposure and training of cost implication is lacking in the current curriculum of LAE certification.

Additionally, to optimize costs LAE need to understand the unique selling proposition and the market positioning of the MRO. This will enable LAE to be part of the team to deliver the unique service experience to their customers at cost that will be beneficial for all parties. With the encroachment of the OEMs into the MRO market, partnering strategies with other MROs is gaining traction. As such LAEs will have to be equip with business knowledge and acumen to be good business partners with suppliers and other MRO providers.

MRO business concept of “power by the hour”, “Beyond Fleet Services”, “Long term Service Agreements” requires good grounding in business and financial basics to enable LAE to effectively participate in contractual negotiations.

3.2 Technology Savvy

Companies wanting to embrace digital transformation must have technological savvy employees. Legacy systems with obsolete technologies have no place in the new digital era. LAEs should be exposed to Big Data Analytics, Machine Learning, Cloud Computing, Internet of Things and Digital Security. Application of these technologies in real-time tracking, digitize work cards and automated inspections will the norm in maintenance activities.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

In the area of MRO teaching and learning, application of virtual and augmented reality will fast-track learning. As an example XMReality, an augmented reality solution provider, provide technical expertise on-demand from any location to help an on-site LAE with a complex technical problem in a remote location.

3.3 Data Literacy

Digital literacy is the core ingredient that galvanized all of the Foundational and Functional competencies to actualize the transformation goals. Technology evolves fast and so data literacy has to keep pace needing continuous upskilling of knowledge. The width and depth of technology is immense and research studies define this concept in many different shades. The concept of literacy in the digital world has assumed new meanings [12]. It is the next wave of specialized communication both digital and visual in form. It is a person's ability to perform tasks effectively in a digital environment. Another view posited it as a combination of technical-procedural, cognitive and emotional social skill [13]. Our framework position data literacy to be the core and it spans the foundational as behavioral outcome and functional as relating to the actual job result. This is in alignment with both of the conceptual definition of the two researchers.

4. Conclusion

The framework proposed outline the requirements for LAE's competency to successfully transform MRO for business continuity into the new digital economy. The broad dimension of the competencies is identified and a coherent depiction is shown. There is ample scope for further investigation into the details of the elements of the competencies and the standards of behavior and performance. These standards will provide assessment of these competencies and will be useful to close gaps in training and development interventions. It is hoped that this initial competency depiction will elicit discussion and dialogue culminating to a robust competency model.

5. References:

[1] M. Harrison, "MRO Forecast and Market Trends," IATA 12th Maintennace Cost Conf., pp. 0–29, 2016.

[2] I. Opportunities and T. O. Accelerate, "Mro 2025," pp. 1–8.

[3] V. E. BADEA, A. ZAMFIROIU, and R. BONCEA, "Big Data in the Aerospace Industry," Inform. Econ., vol. 22, no. 1/2018, pp. 17–24, 2018.

[4] A. Requirements, D. Project, and B. Intelligence, "Global Airline Digital Transformation Programmes, 2017," no. March, 2017.

[5] "Digital Aviation."

[6] P. To and U. Of, "Most Digital Transformations Fail, Here's How To Change That," 2019.

[7] ICAO, Doc 9868 - Training, no. November. 2015.

[8] M. Measures and M. Bagshaw, "Management and leadership: A competency framework to deliver the National Trust's strategy," Ind. Commer. Train., vol. 41, no. 7, pp. 355–362, 2009.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

[9] I. H. A. Razak, S. Kamaruddin, and I. A. Azid, "Implementation of the Workforce Competency Model for assessing maintenance workers' performance," Int. J. Product. Qual. Manag., vol. 7, no. 4, p. 440, 2011.

[10] E. Olsen, "Bridging The Skills Shortage Gap With Augmented Reality," 2017.

[11] S. T. and M. S. U. PeriyarSelvam, T. Tamilselvan, "Analysis on Costs for Aircraft Maintenance," Adv. Aerosp. Sci. Appl., vol. 3, no. 3, pp. 177–182, 2013.

[12] B. R. Jones and S. L. Flannigan, "DIGITAL LITERACY Connecting the Digital Dots: Literacy of the 21 st Century," Nmc.Org.

[13] A. Aviram and Y. Eshet-Alkalai, "Towards a Theory of Digital Literacy: Three Scenarios for the Next Steps," Eur. J. Open, Distance E-learning, pp. 1–22, 2006.