Preliminary investigation of Industry 4.0 readiness among small and medium aviation companies in Malaysia

N H Ghafar¹,², K Harun¹, M S Lailawati³, and N A A Rahman¹

¹Universiti Kuala Lumpur, Malaysian Institute of Aviation Technology, Persiaran A, Off Jalan Lapangan Terbang Subang, 47200 Subang, Selangor, Malaysia
²Putra Business School, Level 3, Office Building of the Deputy Vice Chancellor (Research & Innovation), 43400 UPM, Serdang, Selangor, Malaysia.
³Faculty of Economics and Management, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

*Email: hisyam@unikl.edu.my

Abstract. In recent years, the wave of Industry 4.0 is seen to encroach into the Malaysian aviation industry especially among major aviation companies. However, the Industry 4.0 readiness among small and medium aviation companies is virtually unknown. This study aimed to conduct a preliminary investigation on the Industry 4.0’s readiness level among small and medium aviation companies. Multiple case study has been conducted over 4 aviation companies (1 chartered airlines, and 3 maintenance, repair and overhaul (MRO) companies) operating in Malaysia. Data was collected using qualitative interview with managers of the respective companies and analysed using content analysis. Finding shows that the Industry 4.0 readiness status of small and medium aviation companies are still at the embryonic stage. The practical implication of this study contributes to the understanding of rising need for government agencies’ supports to assist the small and medium aviation companies particularly in overcoming the Industry 4.0 implementation challenges. The purposive sampling and the small number of samples limit the generalizability of the findings. Hence, full fledge empirical study is suggested to be conducted to facilitate the generalization to the whole aviation population.

1. Introduction

Of late, Industry 4.0 has been the central focus among major industries around the globe. Industry 4.0 which involves interaction of both physical and virtual components of the system [1] not only solve production efficiency problems but also creates more business opportunities [2]. In Malaysia, many major aviation companies have been significantly implicated by this new technological emergence which is caused by the spill over effect of Industry 4.0 implementation by duopoly aircraft manufacturers i.e. Boeing and Airbus [3].

However, little is known regarding how far the small and medium aviation companies are aware and ready with the emergence of Industry 4.0. The objectives of this study are first to assessment the Industry 4.0’s awareness status of small and medium aviation companies, and second is to evaluate the Industry 4.0 readiness level of those small and medium aviation companies. Based on that therefore two main research objectives outlined for this study are (1) to investigate how well the
small and medium sized aviation companies in Malaysia understand the Industry 4.0 in aviation, and (2) to assess the level of Industry 4.0 readiness of small and medium sized aviation companies in Malaysia.

2. Literature Review

2.1 Industry 4.0 in Malaysia

Industry 4.0 consists of a combination of cyber physical components, Internet of Things, knowledge, innovation, and talent [4]. Despite Malaysia has been long involved in automation and robotic manufacturing, the idea of Industry 4.0 is quite new [5]. The research on Industry 4.0 in Malaysia is still at the embryonic stages. Nevertheless, most Industry 4.0 research done in Malaysia revolved around the manufacturing sector (for examples in [6], [5], [7], [8], [9], [10]).

2.2 Industry 4.0 technology readiness of small and medium enterprises

Sahi, Gupta, & Cheng [11] asserted that small and medium enterprises (SMEs) explore new opportunities to make profits, and also optimally utilize their existing resources and capabilities. One of those resources is the technology. However, the SMEs’ readiness to adopt new technology peeks the interest of researchers. Adopting the definition of Technology Readiness by [12], Industry 4.0 readiness is defined in this study as the SMEs’ propensity to embrace and use Industry 4.0 for achieving the organizational goals.

Study by Türkeş, Oncioiu, Aslam, Marin-Pantelescu, Topor, & Căpuşneanu [13] on the SMEs drivers and barriers in using Industry 4.0 in Romania found mixed readiness level among the SMEs. Twenty four percent of them were looking for partner to implement the Industry 4.0 technology, twenty six percent already have a partner, and twenty three percent declared that they already have the Industry 4.0 skills, while the remaining twenty seven percent remained undecided. This shows that many SMEs are still not ready and have a long way to go before can seriously and actively embark into Industry 4.0 technology.

In the context of SMEs in Malaysia, Zaidi & Belal [12] who studied the issues relating to Internet-of-Things (IoT) in Malaysian SMEs found that many of SMEs still have the issue of distrust over the Industry 4.0 technology which make them not ready for the technology. Due to that, a more comprehensive industries-wide descriptor of Industry 4.0 technology readiness (also branded as Industry 4WRD) was developed by the Malaysian Ministry of International Trade & Industry [14] to assess the Industry 4.0 readiness levels of companies in Malaysia. The descriptor encompasses five readiness levels as illustrated in Table 1 below. For this paper, the findings from this study were assessed based on this descriptor.

| Readiness Levels | Description |
|------------------|-------------|
| Conventional (Level 1) | Remain ‘as is’ with no intention or initiative to move into Industry 4.0 implementation. |
| Newcomer (Level 2) | Has interest to pursue Industry 4.0 but with none or very little efforts or initiatives. |
| Learner (Level 3) | Has interest to pursue pilot line Industry 4.0 implementation in operation, with existence of planning and strategies, efforts or simple and patches of initiatives being implemented. Ready for some system adoption. |
| Experienced (Level 4) | Has pursued small to medium scale Industry 4.0 implementation initiatives in operation, horizontal integration and ready for large scale system implementation. |
| Leader (Level 5) | Has implemented large scale Industry 4.0 implementation initiatives (company-wide) and system integration. |
3. Research Methodology

3.1 Research design
This study adopted a qualitative multiple case study method by employing thematic analysis. Since the research questions are dealing with the ‘how’ and ‘what’ aspects of the Industry 4.0, case study approach was employed to amplify the understanding on the Industry 4.0 awareness status and readiness level of those aviation SMEs. Multiple cases approach was employed in study because it offers deeper understanding of the outcomes of the cases under investigation [15]. Data was analyzed using thematic analysis where enables the researcher to identify and describe both explicit and implicit ideas within the data through codes and themes [16].

3.2 Case selection
In this study, the sampling frame was derived from the directory of aviation companies published in the Malaysian Aerospace Industry Report 2016/2017 [17]. All aviation companies which categorized as small and medium were firstly extracted. The inclusion criteria was the characteristics of small and medium size based on the standard definition of SME that commonly applied in Malaysia i.e. companies with 5 to 29 full time employees are categorized as small size and companies with 30 to 75 full time employees are categorized as medium size [18]. Five small and five medium sized companies were randomly selected from the refined list and were invited to be interviewed. However, only two small and two medium sized companies agreed to be interviewed. The profile of the selected case companies is depicted in the Table 2.

Table 2. Profile of the selected cases/companies

| Case Id | Interviewee’s Position | Companies’ business activities | Year founded | Number of employees | SME Category |
|---------|------------------------|-------------------------------|-------------|--------------------|--------------|
| 1       | Manager                | Regional-Chartered airlines   | 1994        | 50                 | Medium       |
| 2       | Manager                | Helicopter maintenance, repair, & overhaul (MRO) | 2007 | 24 | Small |
| 3       | Managing Director/Owner | Helicopter maintenance, repair, & overhaul (MRO) | 2015 | 75 | Medium |
| 4       | Manager                | Aircraft maintenance, repair, & overhaul (MRO) – aircraft wheel & brake servicing | 2008 | 10 | Small |

3.3 Data collection and analysis
Data were collected through in-depth qualitative interviews with the managers of the respective companies by a team of three pre-trained research assistants. Each interview lasted between 40 to 55 minutes at the interviewee’s respective company. Each interview was conducted face-to-face with the interviewees in English and audio recorded. One of the interviewer was also assigned a role as note taker and took notes based on his observation over the interviewee’s non-verbal responses as well the company’s workplace surrounding. The recorded audios were then transcribed by the researchers. The written transcriptions were then manually analysed to identify the relevant codes and followed by refining the emerged themes.

4. Result and Discussion
The first research question intended to get the general overview on the companies’ awareness of the impact of Industry 4.0. Finding from the interview shows that all companies were aware, at various degree, that the emergence of Industry 4.0 may have impacted their business operation. Majority of them (i.e. Case 2, Case 3, and Case 4) agreed that one major area of the companies that may be highly affected is the inventory management. They perceived that Industry 4.0 technology may implicate their spare part procurement processes by way of assisting the online ordering and online payment.
**Table 3. Summary of affected areas, companies’ readiness evidences, and conclusion on Industry 4.0 readiness level according to cases companies.**

| RQs | Case 1 | Case 2 | Case 3 | Case 4 |
|-----|--------|--------|--------|--------|
| RQ1: Which areas of your companies that may be affected with Industry 4.0? | Human resource management (i.e. Recruitment) | Inventory management (i.e. spare part purchase.) · Data management (i.e. data retrieval) · Administration (i.e. online forms) | Inventory management (i.e. spare part purchase). | Inventory management (i.e. spare part purchase). · Data management (i.e. data repository) · Administration (i.e. Online reporting & tracking) · Human resource management (i.e. workers optimization) |
| RQ2: What is the company’s Industry 4.0 readiness level? | From interviewee’s response: “The readiness level of this company can be say as we are all (at) gratify or satisfy level.” From researchers’ observation: The company ‘banned’ (interpreted by authors as ‘hesitated to send’) its employees to Industry 4.0 trainings thinking that they are still not ready for the new technology. | From interviewee’s response: “I do not think this small company implement the technology even in the future later.” From researchers’ observation: 1. The interviewee unable to give his personal description about Industry 4.0 in aviation, as if it was the first he heard about the notion. 2. He kept raising the two air crash incidents of Ethiopian Airlines and Lion Air involving the use of Industry 4.0 technology i.e. augmented reality system. | From interviewee’s response: “The company had sent the IT department and technical service employees to Industry 4.0 trainings. After that, they managed to create own software for apply leave online, purchasing spare parts and approval from upper managerial on certain tasks.” From researchers’ observation: 1. Interviewers saw the functionality of the system developed by IT department which has facilitated paperless administrative environment 2. The company has planned to extend the system to aircraft maintenance operation areas. | From interviewee’s response: “We plan to implement in technological section like engineering maintenance and operation.” From researchers’ observation: The manager has identified few Industry 4.0 related courses for the purpose of sending its employees for Industry 4.0 early exposure. |

The second area that may be affected is the data management. Industry 4.0 technology may implicate the way the companies’ information is stored and retrieved for the use of management decision.
making. Apart from that, other areas that may be affected with the implementation of Industry 4.0 technology are the human resource management area i.e. recruitment (Case 1) and workforce optimization (Case 4); as well as the administration area i.e. online form (Case 2) and online reporting/tracking (Case 4). The summary of the affected areas is depicted in Table 3.

The second research question intended to explore the evidences, based from the interviewees’ explicit responses as well as the interviewers’ observations, of the companies’ readiness toward the Industry 4.0 implementation. Both Case 1 (medium size) and Case 4 (small size) are categorized as ‘newcomers’. This judgement is based on the fact that despite both companies acknowledged the important implication of Industry 4.0 on their business, however both were either hesitate or still not ready to invest on the training and development of their human resources on the Industry 4.0 knowledge and skills. On the other hand, one medium sized aviation company (i.e. Case 3) is advancing at the ‘learner’ stage. It took them a bold action by sending its IT and technical staff for Industry 4.0 skill development training, and upon return, they were assigned and then managed to develop a pilot system to support the office automation processes of the company.

On the opposite side however, another small company (i.e. Case 2) chose to remain at conventional level. The company not only reluctant to accept the Industry 4.0, but also having negative perception that investing in Industry 4.0 will lead to negative return on investment particularly in two aspects. First, heavy initial investment in Industry 4.0 technology including sustaining it is beyond the affordability of its small sized company. Secondly, even investing into the development of it human resources with Industry 4.0 skills will be disadvantageous to the company. The trained employees may voluntarily leave the company despite having contractually bonded after the training because of the attraction of lucrative offer from bigger companies. Table 3 summarizes the findings on the Industry 4.0 readiness level of the case companies.

5. Conclusion
The results of this study imply that size of a business entity is matter in determining the technology readiness. However, above and beyond that, the awareness level of the managers or business owner really plays an important role in shaping up how a company’s perceived for technological changes. Two important lessons emerge from this preliminary study. First, no matter how good a technology is, if the companies do not feel that they can get the benefits from their huge investment, they will be reluctant to invest. In the case of aviation SMEs, the aviation business itself already demands huge capital investment to conventionally maintain it. But adding another huge investment in Industry 4.0 technology definitely make them think twice. Therefore, future study is needed to determine what kind of support that the relevant agencies should provide to those aviation SMEs especially when Malaysia want to fully embark into Industry 4.0 throughout the aviation industry.

Second, the professions in aviation industry especially the technical and engineering occupations are already known as highly skilled and highly demanded in Malaysia (NAICO, 2017), but those talents are difficult to retain. But adding new Industry 4.0 skills to those already highly skilled employees will makes them more valuable. The concerns of smaller aviation companies is when those talents becoming more agile and difficult to retain them since they know the value of their valuable skills in global aviation market. In this situation, the conventional way of talent retention will no longer effective. Thus, future study should explore how relationship-based talent retention may replace the conventional physical talent retention method that is becoming obsolete in today’s boundaryless business world.

Despite the limitation of the sample size in this study which hinder the generalizability of the findings, this study serve as an important reality check that aviation SMEs in Malaysia are still not ready with the implementation of the Industry 4.0. Many promotional efforts need to be done by relevant agencies to increase the awareness in those aviation SMEs as much as many financial and non-financial supports need to be given to them in order to sustain the Industry 4.0 technological needs.
6. Acknowledgments
This research is part of initial preliminary research on the implementation of Industry 4.0 in aviation industry in Malaysia. The authors wish to acknowledge the financial and non-financial assistance or encouragement from the management, colleagues as well as research assistants at the Universiti Kuala Lumpur, Malaysian Institute of Aviation Technology, who directly or indirectly involved in this research work.

7. References
[1] Zakoldaev, D. A., Shukalov, A. V., Zharinov, I. O., & Zharinov, O. O. (2019, April). Organization of information exchange between digital companies of Industry 4.0. In IOP Conf. Ser.: Mater Sci. Eng. 510 (1) p. 012021. IOP Publishing.
[2] Safiullin, A., Krasnyuk, L., & Kapelyuk, Z. (2019, March). Integration of Industry 4.0 technologies for “smart cities” development. In Conf. Ser.: Mater Sci. Eng. 497 (1) p. 012089. IOP Publishing.
[3] Zelentsova, L. S., & Tikhonov, A. I. (2019). Differential-Integral Approach to the Competition Resistance Evaluation of Aircraft Engine Manufacturing Organization. TEM J. 8 (1), p. 165-70.
[4] Kamsi, N. S., Firdaus, R. R., Razak, F. D. A., & Siregar, M. R. (2019, April). Realizing Industry 4.0 Through STEM Education: But Why STEM Is Not Preferred?. In Conf. Ser.: Mater Sci. Eng. 506 (1) p. 012005. IOP Publishing.
[5] Bahrin, M. A. K., Othman, M. F., Azli, N. N., & Talib, M. F. (2016). Industry 4.0: A review on industrial automation and robotic. J. Teknologi, 78(6-13), p. 137-43.
[6] Zaidin, N. H. M., Diab, M. N. M., Yee, P. H., & Sorooshian, S. (2014). Quality Management in Industry 4.0 Era. J. of Manag. Sci., 4(3).
[7] Ooi, K. B., Lee, V. H., Tan, G. W. H., Hew, T. S., & Hew, J. J. (2018). Cloud computing in manufacturing: The next industrial revolution in Malaysia?. Expert Systems with Applications 93 p. 376-94.
[8] Jose, R., & Ramakrishna, S. (2018). Materials 4.0: Materials big data enabled materials discovery. Applied Materials Today 10 p. 127-32.
[9] Maavak, M., & Ariffin, A. S. (2018). Is Malaysia Ready for the Fourth Industrial Revolution?: The Automotive Sector as an i4. 0 Springboard. In Analyzing the Impacts of Industry 4.0 in Modern Business Environments p. 41-64. IGI Global.
[10] Adam, I. H. D., Jusoh, A., Mardani, A., Streimikiene, D., & Nor, K. M. (2019). Scoping research on sustainability performance from manufacturing industry sector. Problems and Perspectives in Management, 17(2) 134.
[11] Sahi, G. K., Gupta, M. C., & Cheng, T. C. E. (2019). The effects of strategic orientation on operational ambidexterity: A study of Indian SMEs in the industry 4.0 era. Int. J. of Prod. Econ. doi:10.1016/j.ijpe.2019.05.014.
[12] Zaidi, M. F. A., & Belal, H. M. (2019). A preliminary study to understand the SMEs’ readiness on IoT in Malaysia. Int. J. of Accounting, 4(19) p. 01-12.
[13] Türkeş, M. C., Oncioiu, I., Aslam, H. D., Marin-Pantelescu, A., Topor, D. I., & Căpuşneanu, S. (2019). Drivers and Barriers in Using Industry 4.0: A Perspective of SMEs in Romania. Processes, 7(3) p. 153.
[14] MITI (2019). Industry 4WRD Readiness Assessment. Ministry of International Trade and Industry, Putrajaya, Malaysia. Available at https://www.miti.gov.my/miti/resources/National%20Policy%20on%20Industry%204.0/Industry4WRD_Booklet.pdf
[15] Miles, M.B., Huberman, A.M., & Saldaña, J. (2014). Qualitative data analysis: A methods sourcebook 3rd ed. Los Angeles, CA: Sage
[16] Guest, G., MacQueen, K. M., & Namey, E. E. (2011). Applied thematic analysis. Sage Publications.
[17] National Aerospace Industry Coordinating Office (NAICO) (2017). Malaysian Aerospace Industry Report 2016/2017. Ministry of International Trade & Industry, Kuala Lumpur, Malaysia.

[18] SME Corp (2013). Guidelines for New SME Definition. SME Corporation Malaysia. Available at http://www.smecorp.gov.my/images/pdf/Guideline_New_SME_Definition_updated.pdf.