Analytical assessment on aviation practitioners needs for knowledge enhancement at the postgraduate level: an application of Fuzzy Delphi method

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Abstract. Knowledge enhancement is essential to support continuous sustainability of organization in a competitive environment. It is not an exception to an aviation industry. In facing up with future challenges of industrial revolution 4.0 (IR 4.0), studies have shown that one of the issues addressed in ensuring its success is the importance of knowledge among employees. Various activities can be done to enhance knowledge such as by enrolling to academic (undergraduate or postgraduate) programs, attending short courses/training or sitting for professional certification. Furthermore, obtaining postgraduate degrees offers wide exposure to academic and industry environment. Therefore, the purpose of this study is to gauge the understanding on practitioners’ key reasons to further their education at the postgraduate level. Four major constructs established for this study to analyse the aviation practitioners’ intention to further study that are personal needs for continuing education, organization needs, source of funding and teaching and learning facilities. Document review were conducted at the beginning of the study to explore fundamental issues of knowledge enhancement needs among practitioners, meanwhile survey performed were analysed by using Fuzzy Delphi method (FDM). Findings shows that six elements (items) for the whole survey fulfil the criteria of threshold value (d construct) less than 0.2 and achieved the percentage of expert group consensus more than 75%. This research provides objective and constructive input to university on the major factors influencing aviation practitioner’s decision to further their study at the postgraduate level. The finding becomes avenues for university to draft a better postgraduate program to fulfil the requirement of industry and academic.

1. Introduction
Knowledge and skilful workers are the catalyst for the development of a country [1]. Pursuing formal education at postgraduate level is a continuous improvement that helps many to improve and enhance fundamental and applied knowledge. However, there are other factors that may affect the choices of pursuing study among practitioners. External and internal factors play important role in influencing the practitioners’ decision to pursue their study at postgraduate level. Within education sector that specialises on aviation program, there are very minimal number of postgraduate programs offered by university.
It is even more difficult to find aviation management program courses offered not only within Asia but in another region as well. Scarcity of programs may become external factors that deter aviation practitioners to further studies at postgraduate level. On the other hand, internal factors that gearing them up to further their studies are also important factors to look at. Furthermore, studies on practitioners’ decision to pursue their study at the postgraduate level remains unexplored. Therefore, studies need to be conducted in identifying the factors that influences practitioners’ decision in enhancing knowledge and pursue their study at postgraduate level.

Development of aviation management program at postgraduate level is hoped to fill up the gaps in offering aviation practitioners’ opportunities to upgrade their academic qualification. Development of master’s degree in aviation management is to support the development of future managers in the industry. It is estimated that by year 2030, Malaysia requires a total number of 32,000 aviation workforce [2]. From this figure, there is a conjecture for the compounding needs of numbers of managers and senior executive that requires higher academic qualification.

Malaysia has about 53 education and training institute in aerospace related programmes comprises of 27 higher education institutions, 15 technical academies and 11 DCA (Part 145) approved training organizations [3]. However, the dearth of management program in aviation offered is noteworthy; there is only one bachelor’s degree in aviation management offered currently, and there is no masters’ degree in aviation program offered yet. There is other aviation related program at postgraduate level currently offered in the other region such as Embry Riddle University (United States of America), Cranfield University (United Kingdom) or in Emirates Aviation University (Dubai) but not specifically to aviation management program. In year 2014, 3,637 skilled workers have been produced within South East Asia; Malaysia alone has produced about 54% of the skilled workers within region [3]. In the Asia Pacific region, Malaysia is forecasted to be the forefront in aviation sector. Furthermore, education and training sector are considered as essential in supporting the initiatives as highlighted both in the Malaysia Aerospace Industry Blueprint 2015-2030.

In realizing the emergence needs of an aviation management program at postgraduate level, an online survey was conducted to practitioners in aviation industry; to gauge their feedback for continuing education at the postgraduate level. The survey questionnaire has been distributed among practitioners’ in Malaysia. The major constructs of the survey questions using multi-stage multi-level analysis that comprises of four categories: personal needs for education, organizational needs, sources of funding and teaching and learning facilities. From the education provider perspective, identifying the main objective for prospective students (practitioners) to pursue their academic qualification at the postgraduate level is a golden quest. Since the purpose of this study is to conduct an analytical analysis on respondents’ survey, therefore this study will provide a guide for other researcher in conducting research survey based on FDM. This study contributes for more discussion on FDM use in analysing the survey respondents.

2. Fuzzy Delphi method
Multicriteria decision making (MCDM) tools such as Analytical Hierarchy Process (AHP), Delphi method, Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), VIKOR method and others have been widely used in organization as well as in academic studies. The purpose of using MCDM tools are normally because these tools have been incorporated with consistency checking [4] therefore minimizes subjective influences in decision making [5].

Delphi method developed in 1950s by RAND corporation [6], provide benefits in assessing decision such as: (1) effectiveness of decision making in the absence of past data. (2) survey can be made remotely without face to face and (3) its usefulness in future prediction for new technology or product [7]. However, there are also critiques on the weaknesses of Delphi method as discussed by [7]. Combination of fuzzy set theory and Delphi method introduced by [8] provide stability in the result obtained from analysis.
Study by [9] defined different roles of MCDM tools such as FDM, FAHP and Fuzzy TOPSIS and its application. For instance, FDM is used to determine the important criteria for building the hierarchy in MCDM. Subsequently, FAHP is adopted to elaborate the weight of criteria and fuzzy TOPSIS on the other hand deployed to rate alternatives used in decision making made by decision maker. The practices adopted by [9] accentuating earlier practices discussed by [10]; that adopts the use of modified Delphi in determining and analysing criteria based on the conducted survey. The relation between these three decisions making tools are illustrated by [9] in Figure 1.

![Diagram](image1.png)

**Figure 1**: The three-stage technology selection process

Figure 1 indicated that FDM were assigned to determine criteria and develop the hierarchy prior to further process by FAHP and Fuzzy TOPSIS. The same practice are used earlier by [10] that adopts modified Delphi prior to analysis by FAHP. Similarly, FDM are used to explore important criteria in selection [7,11] and to develop primary evaluation criteria [12,13]. Therefore, we suggest the use of FDM to analyse questionnaire survey conducted among aviation practitioner. Furthermore, most suitable collection of information via group decision making and feedback from experts are to use Delphi method [14]. Survey result were analysed using FDM by performing analytical assessment to investigate the needs of knowledge enhancement among aviation practitioners will witness a concrete and stability in term of the findings and reporting.

### 3. Methodology

Purpose of this study is to analyse the result obtained from survey conducted online. Survey is chosen as the strategy of inquiry to get feedback from aviation practitioners with regards to the needs of enhancing knowledge; by pursuing in the academic program at the postgraduate level (master’s degree). Survey questionnaire were developed on four major constructs built for this study represented in the following Figure 2. Seven items Likert scale are used to acquire respond from the respondent, however the preferential levels are differently used for each question as shown in Table 1.

![Diagram](image2.png)

**Figure 2**: Major constructs built for this study
Survey was conducted online and distributed through referral and contacts within a month using an online form. The advantages of using online survey is costs saving, shorter time to acquire data, access to unique and unreachable population [15] and easier to reach remote users [16]. At the end of the survey period, 55 respondents have responded and answered all questions. The number of respondents is considered enough for the time being; considering the period for the survey (within a month) and has expedited efforts to promote the survey (through referral). Nonetheless, there are still arguments and discussions over the minimum number (15 respondents) and maximum number (50 respondents) for Delphi method [17].

The list of preferential level is shown in Table 1. In overall, there are seven types of preferential level used in this survey. Subsequently, seven items Likert scale and seven points FDM as shown in Table 2 were matched and converted. The whole FDM process was performed using Microsoft Excel 2016. Template for calculating FDM result were developed. The survey result was analysed and included in Microsoft Excel. At the end of the process, findings from the analysis were conducted and reported. The findings of the analysis are discussed in the next section. Analysis of the result for this study was conducted in two stages as described in Figure 3.

Table 1: Preferential Table Used in the Survey Questionnaire

| Suitability Level | Importance Level | High Level | Likeliness Level | Preferential Level | Requirement Level | Agreement Level |
|-------------------|------------------|------------|------------------|-------------------|------------------|---------------|
| Strongly Suitable | Extremely Important | Extremely High | Strongly Likely | Highly Preferred | Highly Required | Strongly Agree |
| Mostly Suitable   | Mostly Important  | Most Likely High | Most Likely     | Most Preferred    | Slightly Required | Mostly Agree  |
| Suitable          | Important        | High       | Likely           | Preferred         | Required         | Agree         |
| Neutral           | Neutral          | Neutral    | Neutral          | Neutral           | Neutral          | Neutral       |
| Not Suitable      | Not Important     | Lower      | Unlikely         | Non-Preferred     | Not Required     | Disagree      |
| Mostly Not Suitable | Mostly Not Important | Mostly Lower | Most Unlikely   | Most Non-Preferred | Mostly Not Required | Mostly Agree |
| Strongly Not Suitable | Strongly Not Important | Extremely Lower | Strongly Unlikely | Strongly Non-Preferred | Strongly Not Required | Strongly disagree |

Figure 3: Analysis steps

- Online survey conducted for a month period (aviation practitioners)
- Respond from non-aviation practitioners not discarded (to understand the intention of non-aviation respondents towards participating or provide feedback about the program.)
- Preferences level used in the survey questions were retrieved from the previous survey.
- List of preferential level is shown in Table 1
Table 2: Matching Table between Likert scale and 7 Point Fuzzy scale
Adopted from [18,19]

| Preferential Level | 7 points Fuzzy Scale | Likert Scale |
|--------------------|----------------------|--------------|
| Strongly disagree  | (0.0,0.0,0.1)        | 1            |
| Somewhat disagree  | (0.0,0.1,0.3)        | 2            |
| Disagree           | (0.1,0.3,0.5)        | 3            |
| Neutral            | (0.3,0.5,0.7)        | 4            |
| Agree              | (0.5,0.7,0.9)        | 5            |
| Somewhat agree     | (0.7,0.9,1.0)        | 6            |
| Strongly agree     | (0.9,1.0,1.0)        | 7            |

4. Analysis and Findings
Results of the survey shows that majority of the respondents from this study are currently an active employee working within aviation industry in Malaysia. Meanwhile, employees from other industry and current students in aviation/aerospace sectors were also involved and provide their feedback in the study. In term of the jobs/employment level as shown in Table 3, majority of respondents are from the executive/senior executive/engineer/officer categories. Second in place, the total number of 15 respondents such as students/lecturer/SL1M (Skim Latihan 1 Malaysia Malaysia Training Scheme program) trainees also participated in the study apart from employee at the managerial/directors’ level.

Table 3: Types of Respondents’ Jobs

| No | Jobs level\areas          | Example                        | Quantity |
|----|---------------------------|--------------------------------|----------|
| 1  | Manager\Director          | Director, Quality manager, Human Resource manager. | 9 respondents |
| 2  | Executive\Senior Engineer\Officer | NOTAM officer, Process engineer, Route revenue analyst, Operation executive, Human Resource officer. | 28 respondents |
| 3  | Education within aviation | Lecturer, Students, SL1M trainee | 15 respondents |
| 4  | Others                    | Pilot, Airforce Inspector, Banking officer | 3 respondents |

Total respondents: 55 respondents

From the business segments of the respondents, Figure 4 shows that majority of the respondents comes from the operations\engineering\technical area within several domains in the aviation sector such as airlines operations, airport, air-traffic controller, maintenance, repair & overhaul (MRO). This figure will lead university for detailed study in future to identify the exact target prospective students for more relevant syllabus preparation.

FDM was conducted on the result from 27 items of survey response; based on the survey questionnaire obtained earlier. From the 29 survey questions, two questions were discarded as both questions are descriptive in nature.
4.1 Conditions and Percentage
FDM outlines two types of conditions needs to be qualified and fulfilled by the result: threshold value $d$ and percentages of expert’s consensus of more than 75% [1]. Survey questionnaire was clustered from four major constructs defined earlier that are personal needs for continuing education, organizational needs, source of funding and teaching & learning facilities. From Table 4, FDM processes shows that six items (elements) are accepted after getting threshold value less than 0.2 and accepted in consensus by the experts after getting the percentage of consensus more than 75%.

Table 4 : FDM process result

| No | Elements | Triangular Fuzzy Numbers | Defuzzification Process | Expert Consensus | Ranking |
|----|----------|--------------------------|-------------------------|------------------|---------|
|    |          | Threshold Value, $d$     | Expert Consensus, $\%$  | $m_1$ $m_2$ $m_3$ | Score   |
| 1  | A1       | 0.3                      | 50%                     | 0.655 0.511 0.502 | 0.790   | ACCEPT 11 |
| 2  | A2       | 0.2                      | 55%                     | 0.718 0.873 0.953 | 0.8470  | ACCEPT 4  |
| 3  | A3       | 0.2                      | 58%                     | 0.747 0.896 0.969 | 0.8789  | ACCEPT 3  |
| 4  | A4       | 0.3                      | 70%                     | 0.636 0.552 0.504 | 0.7612  | ACCEPT 13 |
| 5  | A5       | 0.3                      | 74%                     | 0.736 0.633 0.918 | 0.8291  | ACCEPT 6  |
| 6  | A6       | 0.3                      | 80%                     | 0.651 0.513 0.911 | 0.7851  | ACCEPT 10 |
| 7  | A7       | 0.3                      | 81%                     | 0.635 0.724 0.851 | 0.6516  | ACCEPT 1  |
| 8  | B1       | 0.3                      | 47%                     | 0.555 0.802 0.902 | 0.7097  | ACCEPT 11 |
| 9  | B2       | 0.3                      | 65%                     | 0.640 0.769 0.657 | 0.7012  | ACCEPT 13 |
| 10 | B10      | 0.3                     | 47%                     | 0.586 0.558 0.911 | 0.7515  | REJECT 15 |
| 11 | B11      | 0.3                     | 52%                     | 0.647 0.809 0.911 | 0.7891  | ACCEPT 12 |
| 12 | C12(b)   | 0.3                     | 42%                     | 0.216 0.365 0.540 | 0.3798  | REJECT 26 |
| 13 | C13(a)   | 0.3                     | 33%                     | 0.302 0.518 0.851 | 0.5175  | REJECT 24 |
| 14 | C14(a)   | 0.4                     | 27%                     | 0.531 0.857 0.805 | 0.6745  | REJECT 19 |
| 15 | C15(a)   | 0.4                     | 33%                     | 0.373 0.533 0.660 | 0.5836  | REJECT 22 |
| 16 | C16 DESC  | 0.4                   | Non rating questions   | Non rating questions | Non rating questions |
| 17 | D17(a)   | 0.4                     | 24%                     | 0.276 0.442 0.825 | 0.4473  | REJECT 25 |
| 18 | D18(a)   | 0.4                     | 38%                     | 0.342 0.523 0.704 | 0.523  | REJECT 23 |
| 19 | D19(a)   | 0.3                     | 75%                     | 0.436 0.627 0.783 | 0.6190  | REJECT 20 |
| 20 | D20(a)   | 0.2                     | 67%                     | 0.516 0.716 0.870 | 0.7036  | ACCEPT 17 |
| 21 | D21(b)   | 0.3                     | 85%                     | 0.689 0.813 0.902 | 0.7045  | ACCEPT 9  |
| 22 | D22(b)   | 0.3                     | 70%                     | 0.676 0.527 0.910 | 0.6079  | ACCEPT 8  |
| 23 | D23(b)   | 0.4                     | 65%                     | 0.716 0.445 0.912 | 0.3248  | REJECT 7  |
| 24 | D24(b)   | 0.2                     | 91%                     | 0.776 0.902 0.968 | 0.8770  | ACCEPT 2  |
| 25 | D25(b)   | 0.3                     | 80%                     | 0.733 0.659 0.930 | 0.6487  | ACCEPT 5  |
| 26 | D26(c)   | 0.4                     | 47%                     | 0.433 0.652 0.765 | 0.5570  | ACCEPT 21 |
| 27 | D27(c)   | 0.3                     | 85%                     | 0.522 0.887 0.827 | 0.6788  | REJECT 18 |
| 28 | D28(c)   | 0.3                     | 80%                     | 0.642 0.795 0.690 | 0.7770  | ACCEPT 14 |
| TOTAL ITEMS & | 6                     | 16                     | Non rating questions | 6         |
Threshold value $d$ and Consensus Percentage are conditions used in FDM to display the consensus among experts on the items agreeable in the study; of which the $d$ value must be less than 0.2 and the group of experts consensus must be more than 75% [20]. Inability to get the required value and percentage, items either needs to be removed or require second round of FDM. Defuzzification process were constructed to identify the rank of elements (importance) of respondents’ selection over the decision on enhancing their knowledge at the postgraduate level (master’s degree).

4.2 Threshold Value and Consensus Percentage
This study utilizes questionnaire survey that comprises of 29 questions. However, only 27 questions were analysed using FDM; the other two questions were descriptive in nature. Table 5 shows only six elements are accepted which those questions are getting $d$ value less than 0.2 are items under the personal needs in continuing education and teaching and learning facilities.

Aviation practitioners decided to pursue their study due to their personal needs in enhancing knowledge. This has some reflection to the descriptive figure on the type of respondents’ level of jobs that majority of them are coming from executive/senior/executive/officer level; as opposed to other types of categories. It briefly concluded that the quest for knowledge enhancement among this group is relatively high. It also enlightened that most respondents believe that postgraduate program (masters’ degree) will enhance their managerial skills, they will feel satisfied if they are able to upgrade academic qualification and belief that age does not an issue for continuing education.

On top of their personal factors that influences the decision, second factors related to teaching and learning facilities provided by the university are also important. The result shows that, prospective students appreciated for flexible learning and more practical types of learning as indicated by their choices of prefer classes on modular basis, availability of simulated learning facility and preference of access to e-Resources (learning materials accessible through online/internet). Most 91% of respondents prefer classes on modular basis and having access to e-resources. One of the major significant finding is that, the respondent also prefers the availability of simulated learning facility to combine between academic build up and the industry experience. Therefore, they would be able to link immediately with the experience in the real-life situation.

Table 5: Result of Fuzzy Delphi Method on respondent priority of continuing education

| No | Code | Accepted Item                                      | Threshold d value | Expert Consensus Percentage |
|----|------|----------------------------------------------------|-------------------|----------------------------|
| 1  | A2   | Master program will enhance managerial skills      | 0.2               | 93%                        |
| 2  | A3   | Feel satisfied if able to upgrade academic qualification | 0.2               | 96%                        |
| 3  | A7   | Age does not stop from upgrading education.         | 0.2               | 91%                        |
| 4  | D20(a)| Prefer classes on modular basis                    | 0.2               | 87%                        |
| 5  | D(24(a)| Prefer access to e-Resources                      | 0.2               | 91%                        |
| 6  | D25(a)| Existence of simulated learning facility            | 0.2               | 93%                        |

4.3 Ranking of Items
Table 6 and Table 7 shows the ranking of accepted and rejected items based on the consensus from the expert responds. It is to note that most experts in consensus agreed that personal needs and teaching and learning facilities influences main reason for practitioners in pursuing education. Source of funding for prospective students may not be the main reason at the time the questions was answered. Main reasons...
could be: 1) fees amount was not mentioned in the study and 2) respondents were asked in term of their source of funds but not their capabilities on how to pay for the fees.

Table 6 : Ranking of items – Expert Consensus > 75% (Accepted)

| Ranking of items | Fuzzy Score | Accepted Item                                                                 | Expert Consensus | Category |
|------------------|-------------|-------------------------------------------------------------------------------|------------------|----------|
| 1                | 0.902       | Age does not stop from upgrading education.                                   | 91%              | PN       |
| 2                | 0.877       | Prefer access to e-Resources                                                  | 91%              | TL       |
| 3                | 0.871       | Feel satisfied if able to upgrade academic qualification                      | 96%              | PN       |
| 4                | 0.848       | Master program will enhance managerial skills                                 | 93%              | PN       |
| 5                | 0.847       | Existence of simulated learning facility                                       | 93%              | TL       |
| 6                | 0.829       | Masters’ degree enables to move to another domain                             | 84%              | PN       |
| 7                | 0.825       | Access to campus WiFi                                                         | 85%              | TL       |
| 8                | 0.808       | Must have separate training for study skills                                  | 78%              | PN       |
| 9                | 0.795       | Access to virtual leaning platform                                            | 85%              | TL       |
| 10               | 0.792       | Master’s degree able to increase promotion                                    | 80%              | PN       |
| 11               | 0.790       | Aim to enrol in master’s degree in aviation management related                | 80%              | PN       |
| 12               | 0.789       | People will higher education level may have career mobility                   | 82%              | ON       |
| 13               | 0.781       | Master’s degree able to move upward in organization hierarchy                 | 78%              | PN       |
| 14               | 0.781       | Organization encourage staff to involve in self-development program          | 80%              | ON       |
| 15               | 0.777       | Blended between academic research and industry case study                     | 80%              | TL       |
| 16               | 0.704       | Prefer classes on modular basis                                               | 87%              | TL       |

Table 7: Ranking of Items - Expert Consensus < 75% (Rejected)

| Ranking of items | Fuzzy Score | Accepted Item                                                                 | Experts Consensus | Category |
|------------------|-------------|-------------------------------------------------------------------------------|-------------------|----------|
| 15               | 0.752       | The higher position for a person, the more it demands for academic qualification upgrade | 47%              | ON       |
| 16               | 0.710       | Present job demands for more management skills related.                       | 47%              | ON       |
| 18               | 0.679       | Prefer for final year project to be purely industry case study                | 65%              | TL       |
| 19               | 0.675       | Sources of fund from external sponsorship                                     | 27%              | SF       |
| 20               | 0.619       | Prefer have classes on weekends.                                              | 35%              | TL       |
| 21               | 0.597       | Prefer for final year project to be purely academic research thesis           | 47%              | TL       |
| 22               | 0.530       | Sources of fund from EPF Withdrawal scheme.                                  | 33%              | SF       |
| 23               | 0.522       | Prefer classes at night                                                       | 38%              | TL       |
| 24               | 0.517       | Sources of fund from company’s sponsorship                                    | 13%              | SF       |
| 25               | 0.447       | Prefer have classes between 8am to 5pm                                       | 24%              | TL       |
| 26               | 0.374       | Sources of fund from own saving                                               | 42%              | SF       |

Categories: PN = Personal Needs, ON = Organization Needs, TL = Teaching & Learning facilities and SF = Source of Funding
5. Conclusion

Knowledge can be defined into tacit and explicit knowledge [21]. Acquiring and expanding knowledge is a continuous process whereby enhancement of knowledge can be achieved from formal or informal education. Challenges of universities in the new era is to provide education that can fulfil the needs of industry and produce more knowledge workers. More challenges are foreseeing especially in the upcoming of Industrial Revolution 4.0 (IR 4.0). From the industry standpoint, expansion of intellectual capital assures continuous operations and sustainability of the organization. The analysis used FDM process has successfully defined the main reasons practitioners’ pursuing their studies mainly due to their personal needs and teaching and learning facilities offered by university. Constructively, FDM is one of the MCDM tools used to analyse decision and criteria of respondents by delineating biasness, subjective responds and at the same time retrieve consensus agreement among experts. The result of FDM process provides an early understanding for education and training institute on prospective students’ intention in continuing their education at the postgraduate level. University as the education provider may prioritise to emphasize on the two categories of concern by prospective students that are their personal needs in continuing education at the postgraduate level as well as to provide conducive teaching and learning facilities. In future, further studies may emphasize on the modification to overcome some of the weaknesses with the questionnaire items and the design. Furthermore, the survey was conducted earlier before engaging into FDM process. FDM questionnaire design might be considered in future while designing the questions for more structured type of questions and analysis.

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