International Journal of Psychosocial Rehabilitation, Vol. 23, Issue 04, 2019
ISSN: 1475-7192

Developing an Instrument of Life Balance Factors among Female Engineers who have Family: The Application of Modified Delphi Technique

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ABSTRACT---This study aims to obtain expert approval and consensus on Life Balance construct instrument among female engineers who have family. The purpose of this instrument is to identify the factors that assist women engineers to have a well-balanced life. The technique used in developing this Life Balance instrument is the Modified Delphi technique. This technique was used to obtain consensus among experts in developing the Life Balance items. The instrument development was performed by seven experts who have expertise, experience, and knowledge in career and engineering fields. The initial results (interviews with experts) identified four key factors in achieving Life Balance which were childcare, flexible career, leave, and social support. An example of how to obtain an interquartile range (IQR) value using the Modified Delphi technique that was carried out for a second time until the consensus was achieved was provided. IQR value is a value derived from questionnaires completed by experts to obtain consensus on construct items and the data were analysed using Microsoft Excel.

Keywords---*Life Balance, Modified Delphi Technique, Interquartile Range, Female Engineers.*

I. INTRODUCTION

Life Balance is a policy established by an organisation to enable employees to perform their tasks efficiently. The focus of Life Balance policy is to provide employees flexibility in dealing with personal problems (Abioro, Oladejo, & Ashogbon, 2018). Life Balance also represents a balance between their work and personal life which enables employees to be happy while working. Meenakshi, Subrahmanyam and Ravichandran (2013) and Reddy et al. (2010) stated that Life Balance exists from one's perception where there is a compatibility in both working and non-working activities, and it promotes growth according to one's current lifestyle. As such, Life Balance is viewed as a solution in helping employees to balance working and non-working commitments to remain committed to their career.

Recognizing the criticality, a study on female employees' Life Balance was conducted. This paper highlights the application of Modified Delphi technique as a data analysis method in several stages of the study. This study aims to gain experts consensus on the items for the Life Balance (LB) construct that has been carried out among a group of experts related to career and engineering fields.

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Received: 15 Sept 2019 | Revised: 17 Oct 2019 | Accepted: 15 Nov 2019

Life Balance is an instrument developed based on the factors influencing career retention among female engineers. Empirical evidence highlight some differences between male and female workers in factors that contribute to work-life balance. In addition, there were studies which showed that work-life balance offers more positive vibes for working and family women (Mani, 2013). According to Sandhya (2012) and Lakshmi, Nigam, Mishra (2017), work-life balance can improve the efficiency and intelligence of female workers in daily management. Women who achieve work-life balance also found satisfaction, achievement, and happiness in their lives (Lazăr, Osoian, Rațiu, 2010). Therefore, women need to have a well-balanced lifestyle to keep them calm and happy in carrying out their responsibilities at work and home.

PROBLEM STATEMENT

Labour force among female engineers in Malaysia increases every year, but the number continues to decline when they are getting old. Women's Aid Organisation (WAO) Report (2013) stated that in the technical and engineering fields, female workers made up only 31% of the total graduate student population. The study by Balamuralithara, Foon, dan Mohamed Nor Azhari (2014) also noted that the number of female graduates in engineering course in 2010 is unequivalent with the number of engineers for the following year. Statistics from the Malaysian Engineers Board (2017) have demonstrated that out of 10,413 registered engineers, only 745 were female engineers. These statistics are quite different from the number of graduates in 2016 in the technical field where there were 7005 women graduates. The National Statistic Foundation Report (2017) also reported that more female students possess degrees in chemical, materials, industrial, and civil engineering compared to aerospace, electrical, and mechanical engineering, yet only 14.5% of working engineers are women. It can be concluded that female undergraduates in engineering are less interested to work as engineers in the long run.

Women cannot be separated from family issues, especially after marriage. As mentioned in the Economic Transformation Program (ETP) Report (2014), many women will leave the employment sector despite years of experience to get higher job status due to their personal commitment regarding household matters. In addition, the Women's Aid Organisation (WAO) Report for 2013 stated that the household responsibilities were a major factor for them to not work. Besides, some change their career prospects from different fields of study such as legal or medical studies, but they worked as an educator (Li et al., 2011) or find jobs that can be done at home due to family reasons (Awino, Senaji, Kidombo, 2018). Career shifts affect women's shortcomings in engineering, and it has resulted in fewer female mentors (Kodate, Kodate, &Kodate, 2014; Kaewsri&Tongthong, 2014). Therefore, these issues need to be addressed to prevent other women from being demotivated to continue working.

For this reason, the items developed in this instrument were applied with elements of Life Balance that fit the situation and the career schedule of female engineers in Malaysia. Hassan (2016) and Faizal et al. (2017), explains that an organisation must take voluntary steps to create an environment that engages employees to work long-term. Das and Baruah (2014) pointed out that employees who are happy and satisfied with their work will be more dedicated to their work and are always determined to serve their organisations. In addition, high-commitment employees refer to individuals who have a high demand for being secured in the organisation. This is because similar commitments in career and family help employees to achieve job satisfaction and stay with an organisation (Hanif, Khalid, & Khan, 2013; Sembiyen, 2016). Therefore, there is a need for researchers to consider both organisational and personal influences to ensure female employees can achieve a well-balanced life.

The main objective of this paper is to validate the Life Balance instrument for career professionalism in the engineering industry. Verification was carried out with experts at each stage of the questionnaire to obtain high-quality and valid items from experts using the Modified Delphi technique. These requirements focus on four key areas which are flexible career, childcare, leave, and social support.

II. RESEARCH METHOD

Modified Delphi technique was employed to obtain expert consensus on LB items developed based on the interview findings. The interviews were conducted through an analysis of the administrative needs on LB which involved the experts. This paper does not discuss the initial findings of the interviews but focuses on using Modified Delphi to analyse the interview findings.

The study involved seven experts who comprise of lecturers from higher educational institutions and engineers in Malaysia. The appointed experts were professionals in career, leadership, technical and vocational, and management. The instrument of the study was a questionnaire containing 32 items from four small constructs under Life Balance. These items were developed based on the findings from previous research interviews.

In order to implement the Modified Delphi technique in this study, the researchers first identified and compiled the items provided through interviews in a well-ordered format and accessible by a panel of experts. Subsequently, the researchers identified a group of experts who agreed to contribute their expertise in expressing ideas, criticizing, and improving the content of the items that the researchers had identified (Alwi&Kamis, Jan. 2019, Bushra Limuna, Arasinah, Che Ghani, 2018). Researchers have first contacted the experts to confirm their agreement to be the respondents for several stages until the item consensus was reached. Once all experts have expressed their consent, a letter of appointment was made and submitted either by hand, post, or electronic mail.

Three stages questionnaires were distributed to all experts. During the first stage, the experts were interviewed to state the items that they agreed verbally. The data were analysed using a qualitative software, Atlas.ti. During the second stage, the experts were asked to state their level of agreement on each item whether they Strongly Agree, Agree, Slightly Disagree, Disagree, or Strongly Disagree. Open-ended questions were provided if the experts intended to add items to each construct. This stage allowed to provide their own views on each item. Once all the experts have reached their respective level of agreement, the data from the Likert Scale were extracted into quartile numbers and analysed using Microsoft Excel.

The data from the Likert Scale obtained in the second stage were translated into Modified Number data and analysed using Microsoft Excel. This data analysis technique is known as the Modified Delphi technique. Expert comments and suggestions were also considered to improve the items related to leadership.

In this study, the collection and analysis processes of Modified Delphi technique were carried out in three stages. The first stage is the process of obtaining constructs and items through interviews. The second stage and third stage were conducted to reach a high level of agreement among experts. In each stage, every expert was given some items and each item was displayed on a Likert scale and a blank space was provided for descriptions, comments, or expert suggestions.

III. DATA ANALYSIS AND RESULTS

There are two important aspects in Modified Delphi technique. The first is the interquartile range (IQR). IQR is used to produce a Modified scale to translate linguistic variables into Modified numbers. The level of agreement or Modified scale level ranges from 0 to 1.00, 1.01 to 1.99, and 2.00 and above. IQR of 0 to 1.99 indicates that there is a consensus among experts whereas IQR 2.00 and above indicates no expert agreement and the item should be removed. In the second stage, the data obtained were analysed using Excel for better scheduling. All data were converted to IQR form. An example of the Modified scale is the Three-point Modified scale. Table 1 shows that the less the number on the scale, the higher the data obtained. To obtain expert consensus on each item, the IQR value should not exceed 2.0.

Table 1: Three-point Modified Scale

Agreement Scale	Modified Scale	Result
High agreement	0 to 1.00	Item accepted
Medium agreement	1.01 to 1.99	Item accepted
No agreement	2.00 and above	Item rejected

The rationale for using this technique is to obtain expert opinion on each item without having to meet in public and the identity of each selected expert is kept a secret so that the expert could be independent in suggesting and marking the modified scale based on his or her personal opinion. The Modified Delphi technique is a technique that can gather expert opinions and ideas on each element without knowing the identity of other experts (Nashir, Mustapha, Yusoff, 2015).Here are some sample analyses in verifying items for each construct. Examples of IQR value analyses are leave construct and social support construct. Based on Jubri, Mohamad, Nashir and Subri (2019), the IQR value estimation is based on the formulas in Table 2.

Table 2: IQR Formula

Steps to identify IQR value:
1. The Expert Agreement Scale value should be arranged from small values to large values for each item.
2. Use the formula in Excel to find Quartile 1 (Q1) value and Quartile 3 (Q3) value.
3. IQR value = Q3 - Q1

Table 3 shows a list of items for leave construct which consist of seven items before they were distributed to the experts and the value of IQR expert consensus for the second stage and third stage construct items. According to the table, only item C6 and item C7 were removed because the IQR values were 2.1 and 2.3 in the second stage. Peck and Devore (2007) mentioned that items with IQR value ≥ 2.00 obtained no consensus among experts on the item. In the third stage, all items received the IQR value of <2.00. Therefore, all items were accepted and included in the actual questionnaire.

Received: 15 Sept 2019 | Revised: 17 Oct 2019 | Accepted: 15 Nov 2019

Table 3: Items for 'Leave'

	Item	Stage 2	Stage 3
	I achieve a healthy work-life balance when …		
C1	family emergency leave is separated from annual leave.	0.6	0.3
C2	sick leave is separated from annual leave.	0.1	0.1
C3	there is a long maternity leave (3 months under the Employment Act 1955).	0.1	0.1
C4	there is an opportunity to take maternity leave even if it is half paid.	0.8	0.5
C5	there is a special leave to take care of sick family members.	0.6	0.6
C6	there is an additional maternity leave even if it is half paid.	2.1	-
C7	there is maternity leave for father (husband) even with pay deduction.	2.3	-

Table 4 demonstrates six items for social support construct before they were distributed to the experts. However, after going through the second stage and third stage as shown in the table, there were no missing items. Therefore, the items listed in Table 4 remained. No items were removed because all IQR values ranged from 0 to 1.99. According to Peck and Devore (2007), IQR values from 0 to 1.99 means that there were a high consensus among experts on the items.

Table 4: Items for 'Social Support'

	Item	Stage 2	Stage 3
	I achieve a healthy work-life balance when …		
S1	I receives moral support from colleagues.	1.3	0.3
S2	my co-workers help me complete my tasks during family emergencies.	1.1	0.1
S3	the employer restricts the discussion of work matters only during working hours.	1.8	0.8
S4	the employer provides family policy in career practice.	0.3	0.3
S5	my husband helps me to take care of household needs when I have longer working hours.	1.0	0.5
S6	my husband helps me to take care of our children's needs when I need time for myself.	0.8	0.5

IV. CONCLUSION

Using Modified Delphi technique, the researchers considered all the comments and suggestions from the experts for improvement purpose. Once the items were rearranged after the item removal process, the sentences of each item were modified and refined. The results showed that five items in the 'leave' construct and six items in the 'social

support' construct were among the items to be emphasised in Life Balance. Hence, it is important to carry out this study to examine the necessary items for female workers, especially female engineers in Malaysia. Therefore, it is critical for policymakers in the organisations to consider the needs of their workers in order to become a high-income country and retain high-skilled workers in this era of globalisation. In addition, the employees' needs should be considered in order to help female engineers stay employed. This is in line with the main goal of Human Resource Management (HRM) which is to improve organisational performance.

Having a productive and consistent workforce, especially senior workers in an organisation is necessary to motivate other female employees. Hence, various stakeholders should strive to improve and design their existing plans in a more systematic way. Malaysia has the potential to become an international technical industry hub if every organisation's administrator in the technical industry strives to attract high-skilled female employees to serve and share their skills and knowledge for the betterment of the next generation.

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