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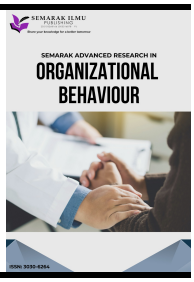

Exploring Need Satisfaction in IT Professionals: The Role of Employee Engagement in Flexible Work Arrangements using Fuzzy Delphi Method

Chan Ler-Kuan[1,*], Tan Shen Kian[2], Lee Huah[3]

[1] Department of Computer Science, Faculty of Engineering and Information Technology, Southern University College, 81300 Johor Bahru, Johor,
[2] Faculty of Business, Raffles University, 79100 Iskandar Puteri, Johor, Malaysia
[3] Department of Postgraduate Studies and Quality Assurance, Faculty of Business & Management, Southern University College, 81300 Johor Bahru, Johor, Malaysia

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ABSTRACT

IT companies like Microsoft and Google have been investing in data centres in Malaysia from the start of 2024. However, IT professionals prefer working abroad due of the favourable currency rate. IT professionals have persistently embraced flexible work arrangements since the pandemic, enabling businesses to access a wider talent pool and enhance employee retention more efficiently. The objective of this study is to investigate the employee engagement model among IT professionals who practise flexible work arrangements and examine its influence on the satisfaction of their needs. The study implements the Fuzzy Delphi method, employing a mixed method research approach. During the initial phase, a series of qualitative semi-structured interviews were carried out with 6 IT professionals who had over 5 years of job experience. The qualitative data was analysed using deductive thematic analysis to discover important themes associated with employee engagement and need satisfaction. During the second phase, a questionnaire was handed out to 10 IT professionals who have over 10 years of working experiences. The purpose was to validate the findings and reach a consensus on the discovered factors. The findings provide strong proof of expert consensus, with a 75% agreement rate on all factors relevant to employee engagement and need satisfaction. These findings suggest that the elements listed are crucial for improving the fulfilment of needs among IT professionals in the context of flexible work arrangements. The study offers useful information to organisations, allowing them to build more strategic strategies for involving IT professionals in flexible work arrangements. Overall, this research contributes to the existing literature on employee engagement and need satisfaction in the context of flexible work arrangement, particularly within the Malaysian ICT industry.

* *Corresponding author.*
E-mail address: lkchan@sc.edu.my

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1. Introduction

According to eStatistik [1] the report, 1.21 million people were working in Malaysia's Information and Communication Technology (ICT) business when the economy began to recover in 2021. To further understand the current job design, according to the results of a poll conducted by the DevKaki Facebook group in December 2022, most respondents (53.4%) reported working in a hybrid fashion [2]. This indicates that they were allowed to divide their time between working in-person and remotely. In addition, the poll results reflect the shifting job environment of the modern professional information and communications technology business [2]. Companies need to rethink their flexibility models to meet the requirements of various age groups, genders, and job kinds. This will increase their ability to recruit and keep talented employees. As society returns gradually to normalcy, this trend will continue.

1.1 Research Background

A press release issued by the Ministry of Health (after that MOH) dated 24 March 2022 where the Government announced the reopening of Malaysia's International borders for travellers from all countries effective 1 April 2022 [3]. Many industries' working-from-home culture is switching back to the former work environment or culture. The poll performed within the Developer Kaki (thereafter devKaki) Facebook group in December 2022 that received 577 replies revealed that participants have a variety of work arrangements [2]. 22 % of respondents indicated that they work in person, indicating a sizeable proportion of individuals who physically attend their workplaces.

In contrast, 24.6% of participants reported working entirely remotely, indicating that many people perform their professional obligations from the comfort of their homes or other remote places [2]. Most respondents, 53.4%, reported working in a hybrid manner, indicating they could divide their time between in-person and remote settings [2]. These data illustrate the variety of work arrangements among the devKaki community, which reflects the changing employment landscape in the contemporary professional ICT industry [2]. In addition, IT companies like Microsoft, Google and NEC Malaysia have been investing in data centres in Malaysia since the start of 2024 [4-6]. However, IT professionals prefer working abroad due to the favourable currency rate. IT professionals have persistently embraced flexible work arrangements since the pandemic, enabling businesses to access a wider talent pool and enhance employee retention more efficiently.

This study examines employee engagement among ICT employees in Malaysia who implemented Flexible Work Arrangements (thereafter FWA) toward need satisfaction. The government's FWA@Workplace programme actively promotes FWA as the preferred mode of employment [7,8]. The global COVID-19 pandemic has driven businesses, including those in Malaysia, to adopt work-from-home (WFH) policies to maintain operations and sustain production [9]. As society returns to normalcy, firms must reinvent their flexibility models to fit the unique demands of various age groups, genders, and job types, thereby boosting their capacity to recruit and retain talent [8]. By establishing and implementing FWA, firms can create a work-life-friendly environment where workers can tailor their work arrangements to their specific preferences and needs [10].

1.2 Research Problem

The Employment (Amendment) Act 2022 ("the Amendment Act"), whose effective date has been set for 1 September 2022 by the government, enables Malaysian employees to request FWA [11,12]. This may be the beginning of many such reforms because FWA has never been fully recognized in

Malaysia [8,9,12]. Employers in Malaysia should start planning now as they can anticipate an increase in the prevalence of FWAs soon [7,9,12].

The introduction of the Employment (Amendment) Act 2022, which permits Malaysian employees to request FWA, has prompted worries and criticism from a variety of parties, such as the SME Association of Malaysia, Malaysian Employers Federation (MEF), Associated Chinese Chambers of Commerce and Industry Malaysia (ACCCIM) and Malaysian Trades Union Congress (MTUC) [13]. Concerned about the harmful impact of FWA on production capacities and labour shortages, business groups advocate limiting the use of FWA to specified industries [14,15]. On the contrary, the ICT industry enthusiastically supports the implementation of FWA [2]. With the use of FWA, work turnover is reduced by allowing employees to perform their jobs outside the office, relying on various means of communication [16]. Despite the growing trend of FWA research, there is limited research on the impact of employee engagement on employee well-being and need satisfaction.

1.3 Research Objectives

This study attempts to systematically identify and examine the fundamental elements that impact employee engagement and need satisfaction among IT professionals operating within the context of FWA. Firstly, the primary factors that promote employee engagement within the FWA setting must be identified. Secondly, pinpoint the essential aspects of need satisfaction relevant to IT professionals functioning under FWA circumstances. The primary goal of this study is to offer a comprehensive conception of how FWA influences employee engagement levels and need satisfaction, thereby providing valuable insights for organizational strategies and policies within the ICT industry.

1.4 Significant of Study

This study seeks to advance the comprehension of employee engagement and FWA within the realm of need satisfaction. It aims to present an all-broad range of factors, such as integrating artificial intelligence and regulatory frameworks, while leveraging extant empirical research. By examining theories and empirical literature in this domain, the study will compare and combine them to formulate an understanding of factors and outcomes. The results are expected to benefit governmental bodies and the ICT industry, offering insights into the fundamental factors of employee engagement among IT professionals and their uptake of FWA. The study's results will prove valuable for the human resources division of ICT companies and the Ministry of Human Resources (MOHR) and Ministry of Higher Education (MOHE) in overseeing the advancement of implementing FWA and developing forthcoming workplace or work schedule schemes [10,17]. Furthermore, manufacturing remains crucial, and the New Industrial Master Plan (NIMP) 2030 aims to foster knowledge-led growth and economic diversification across Malaysia [18,19]. The study's conclusions are expected to refine the approach to implementing FWA among IT professionals in Malaysia and function as a blueprint for other sectors with similar job scopes.

2. Literature Review

The following subsections discuss the relevant literature on employee engagement and the need for satisfaction among IT professionals who practice FWA post-pandemic.

2.1 Employee Engagement

Human resource management relies heavily on employee engagement to ensure job satisfaction and match the workforce with company objectives. The COVID-19 pandemic has altered the adoption and practises of human management solutions, with remote work becoming the "new standard." The relationship between employee satisfaction, performance, and engagement is close, with high satisfaction resulting in enhanced performance and engagement [20]. Effective leadership is essential for organisation management, highlighting the significance of employee attitudes, contentment, loyalty, and engagement [21,22]. Employee engagement is influenced by religiosity and employee empowerment, with religious characteristics having a counterbalancing effect and employee empowerment predicting engagement [23]. Social resources, such as the Ubuntu concept, mediate the relationship between social interaction and employee engagement [24]. Table 1 shows the literature review matrix on the employee engagement model.

Table 1
The literature review matrix on the employee engagement model

No	Antecedent of EE model	Definition	Source
1	Organisation support	The belief held by employees that their organisation values their contributions and cares about their well-being.	[25-29]
2	Employee feedback	The information provided by employees regarding their experience, opinions, and suggestions within an organisation.	[30-33]
3	Leadership	The influential role played by leaders in guiding their followers towards achieving organisational goals.	[28, 34-37]
4	Organisation commitment	Employee' psychological attachment to their organisation, influencing their decision to stay or leave.	[25, 29, 30, 38]
5	Job characteristics	The specific attributes and features of a job that influence employee engagement and satisfaction. These characteristics include aspects such as autonomy, task significance, task identity, variety, feedback, skill variety and job resources.	[28, 38, 39]
6	Transparent organisational communication	The dissemination of truthful, substantial, and complete information within an organisation to encourage active employee participation in information acquisition and distribution.	[21, 34, 35]
7	Reward	A form of recognition or benefit provided to individuals in response to their contributions or performance within an organisation.	[28, 32, 33]
8	Supervisor support	The assistance, guidance and care provided by a supervisor to their subordinates in the workplace.	[24, 28]
9	Training and development	The process of providing employees with opportunities for growth, enhancing their competence and strengthening their personal resources.	[28, 36]
10	Job trust	The belief and confidence that employees have in their organisation, superiors and colleagues.	[21, 29]
11	AI adoption	The integration and utilisation of artificial intelligence technologies within organisations.	[21]

2.2 Need Satisfaction

The need satisfaction framework is a theoretical technique implemented in many sectors to assess how an individual's needs influence outcomes such as well-being, retention, care provisioning, and transport planning [40]. This paradigm centres on comprehending the contentment of essential human needs, such as autonomy, competence, and relatedness [41]. By evaluating the extent to which needs are met, researchers can ascertain the efficacy of interventions, service provision, and policies in addressing the varied needs of individuals [42,43]. The need satisfaction framework offers

a systematic approach to assess and increase outcomes by addressing elements that facilitate or delay these fundamental requirements, ultimately resulting in improved well-being, retention, care provision, and travel planning strategies.

2.2.1 Autonomy

Autonomy is a natural need for individuals to behave autonomously, make voluntary decisions, and possess a feeling of control over their actions [41,43]. Autonomy is crucial for individual well-being and job satisfaction in nursing [44]. It enables professionals to apply their clinical expertise within well-defined tasks and responsibilities. Autonomy, a fundamental psychological need, plays a pivotal role in motivating individuals and increasing their level of involvement in their work, ultimately resulting in improved outcomes, particularly in healthcare environments. Refer to Meirinhos, *et al*., [45] autonomy is defined as the desire to have ownership of one's behaviour and take responsibility for it.

2.2.2 Competence

Competence is the desire to experience effectiveness in mastering tasks or achieving desired outcomes through behaviour [44]. In nursing, competence is measured by adapting, integrating professional judgment, demonstrating clinical skills, and applying knowledge effectively in various situations [41]. The satisfaction of the need for competence is crucial for optical motivation and well-being as it allows individuals to feel capable and effective in their roles, including job satisfaction and work engagement [46]. Additionally, fulfilling the need for competence has been linked to improved patient outcomes, highlighting its significance in the healthcare sector [47].

2.2.3 Relatedness

Relatedness, in the context of need satisfaction theory, pertains to the reciprocal sense of having supporting associations with co-workers and a feeling of belongingness with others, wherein individuals internalize and embrace the ideals of their peers [41]. This notion is essential for achieving the highest level of motivation and well-being. It enables individuals to feel understood and valued and connect with others on a deeper level by sharing their personal stories [41, 43]. This goes beyond surface relationships and leads to emotional ties that boost one's sense of dignity and self-esteem in the workplace [41,48]. In the context of healthcare professionals like nurses, relatedness plays a significant role in creating a work environment that supports psychological needs, leading to improved job satisfaction, optimal functioning, and ultimately better patient outcomes [41].

2.3 Flexible Work Arrangements

Flexible work arrangements (FWA) are organizational practices that offer employees freedom in task execution. This encompasses choices like adjustable work schedules and remote job opportunities [29]. FWA has attracted considerable interest because of its potential advantages, such as its positive associations with employee engagement and job performance [49]. These setups enable employees to achieve a better work-life balance and have control over their work schedule, location, and methods, resulting in higher productivity and job satisfaction [29]. Organizations utilize FWA to tackle commuting time, work-life conflict, and employee well-being [50]. FWA implementation varies in different nations and industries, with constraints limiting adoption in some

circumstances [51]. FWA provides a versatile and adjustable method of work that can be advantageous for both people and organizations. Table 2 shows the phases related to telecommuting evolved through the ProQuest Research Database (created by the author).

Table 2
Phases related to telecommuting evolved through the ProQuest Research Database (created by the author).

Year	Phrases related to telecommuting	Sources
1973	Telecommuting	[52]
1992	Flextime	[53]
1995	Flexible work arrangement	[54]
2002	Telework	[55]
2010	Work from home	[56]
	Hybrid work model	[57]
2017	Remote work options	[58]

2.4 Conceptual Framework

This study examined the ongoing discussion on the rise in employee engagement among IT professionals who practise FWA. Understanding the crucial employee engagement aspects for organisations is essential for gaining valuable insights to effectively retain personnel and align them with the business objectives. Figure 1 illustrates the conceptual framework that visually represents the theoretical concepts of the employee engagement model and needs satisfaction within the context of FWA.

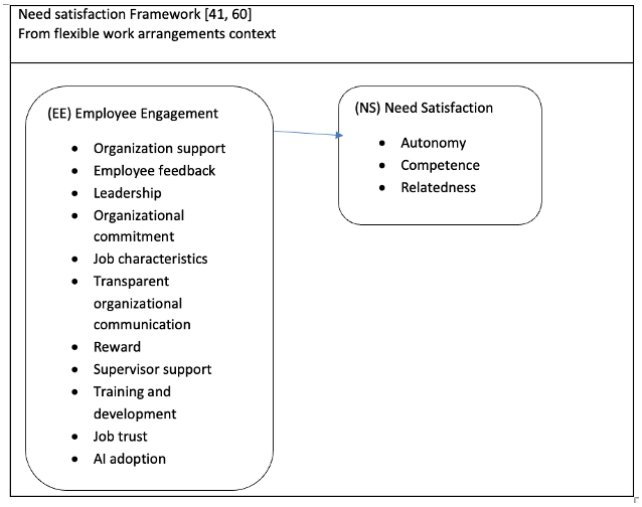

Fig. 1. The conceptual framework of this study

3. Methodology

The following sub-sections discuss the methodology of this study.

3.1 Research Design

The study design integrates the four phases of the Fuzzy Delphi Method (FDM) (see Figure 2) [59, 60], effectively merging qualitative and quantitative approaches [61]. Initiation of the process involved qualitative semi-structured interviews, involving expert interviews and discussions to collect thorough and detailed data [62]. Subsequently, a comprehensive examination was carried out in the

second phase to identify crucial themes and perspectives. The second phase incorporated quantitative methods, employing fuzzy logic to assess and enhance the recognized themes, addressing any ambiguities and contradictions. The final phase focused on establishing agreement among the experts, reinforcing the research outcomes, and enriching their pragmatic significance and applicability [63].

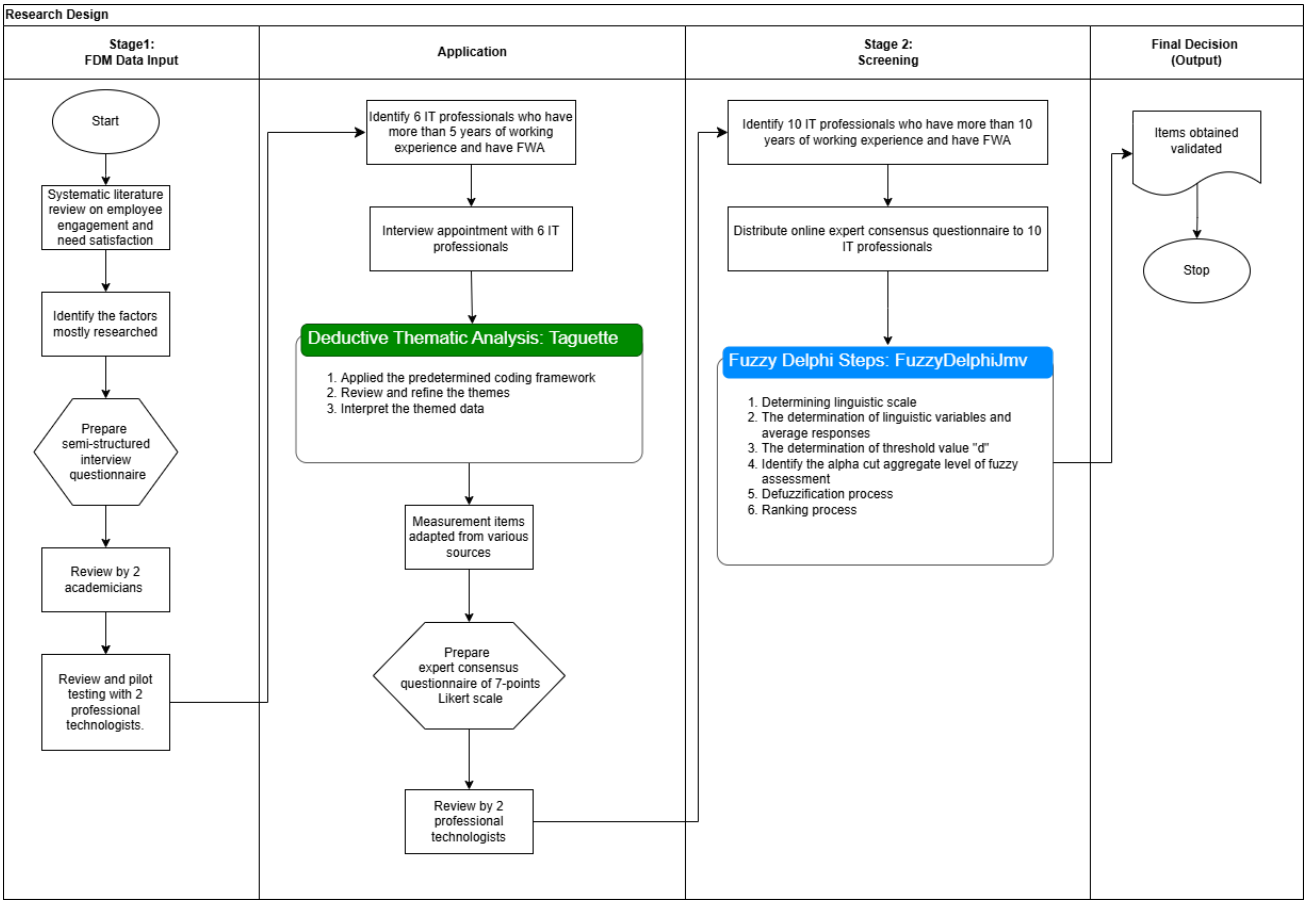

Fig. 2. The Fuzzy Delphi procedure demonstrates the four stages of FDM, including qualitative expert interviews, deductive thematic analysis, quantitative fuzzy logic assessment, and consensus creation

3.1.1 Qualitative semi-structured interviews

Qualitative research employs a subjective and systematic method to investigate and describe the aspects that contribute to employee engagement and need satisfaction, possibly revealing new rankings [64, 65]. The semi-structured interview questionnaire was developed based on the literature review. Two professors who possess extensive knowledge in qualitative research evaluated the questionnaire. To clarify the questions for the target study group, a pilot test was conducted with two experienced professional technologists recognized by the Malaysia Board of Technologists (MBOT) with over a decade of industry expertise [66].

3.1.2 Quantitative Expert Consensus Questionnaire

Once we identified the eight primary components of employee engagement, we constructed the items using relevant prior research as our guidance. The questions were subsequently modified to

suit the context of FWA. Two professional technologists reviewed the initial set to ensure the relevance and clarity of these questions. The item questions are rated on a 7-point Likert scale [60, 67]. Based on their feedback, the number of items was reduced to 69 (Table 3). Subsequently, an English scholar was consulted to assess the language adequacy and cultural compatibility of the questions for IT professionals in Malaysia. This comprehensive procedure ensures that the final compilation of questions is systematic and relevant to Malaysia's ICT industry's specific cultural and professional setting, hence enabling precise assessment of employee engagement aspects. The careful and thorough adaptation and validation stages highlight our methodological approach's strength and effectiveness, improving the research instrument's dependability and accuracy.

Table 3
Measurement items adapted and scaled from relevant literature

Variable		Factors	Adapted scales	Number of item scales
Latent Variable	Employee engagement	Reward	[68]	8
		Transparent organization communication	[69]	7
		Job trust	[21]	5
		Training and development	[70]	5
		Organization support	[68]	7
		Job characteristics	[71, 72]	6
		Supervisor support	[68]	4
		Employee feedback	[73]	7
Consequences	Need satisfaction	Autonomy	[74]	6
		Competence	[74]	6
		Relatedness	[74]	8
			TOTAL	69

3.2 Data Collection

As shown in Table 4, the participants' selection of stage 1 FDM data input is determined through purposive sampling. Prior to scheduling the interview appointment, a letter of invitation and consent was emailed. The entire interview session was carried out and recorded using Microsoft Teams [65].

Table 4
Expert group for qualitative interview

Respondent	Gender	Years of Experience	Job Position	Managerial Level
P1	Male	21	Founder	Top management
P2	Male	10	Founder	Top management
P3	Female	13	Consultant	Non- management
P4	Female	20	IT Project manager	Non-management
P5	Male	26	Founder	Top management
P6	Male	5	Project Manager, Business Development	Non-management

It is ideal to have a diverse group of specialists with different IT backgrounds and expertise who cover all aspects of the problem domain. A purposive sample was used to pick ten specialists with over ten years of professional experience [75]. During the phase of obtaining expert agreement, the researcher distributed an online expert questionnaire to the ten specialists listed in Table 5.

Table 5
Classification of experts

Expert	Gender	Years of experience	Industry	Position
Expert1	Male	19	Web application	Top management
Expert2	Female	14	Logistics Data and IT support	Non-management
Expert3	Male	14	Mobile application development	Non- management
Expert4	Male	14	IT solution consultancy	Non-management
Expert5	Male	26	3D gaming, interactive dashboard	Top management
Expert6	Male	21	IT support	Top management
Expert7	Male	15	Software house	Top management
Expert8	Male	14	Software house	Non- management
Expert9	Male	13	FinTech	Non- management
Expert10	Male	17	Software house	Top management

3.3 Data Analysis

3.3.1 Deductive thematic analysis

Deductive theme analysis is utilised to derive the coding from the transcribed interview [76]. Taguette was utilised to extract the coding [77]. A revised ranking of employee engagement criteria has emerged following the analysis in Figure 3.

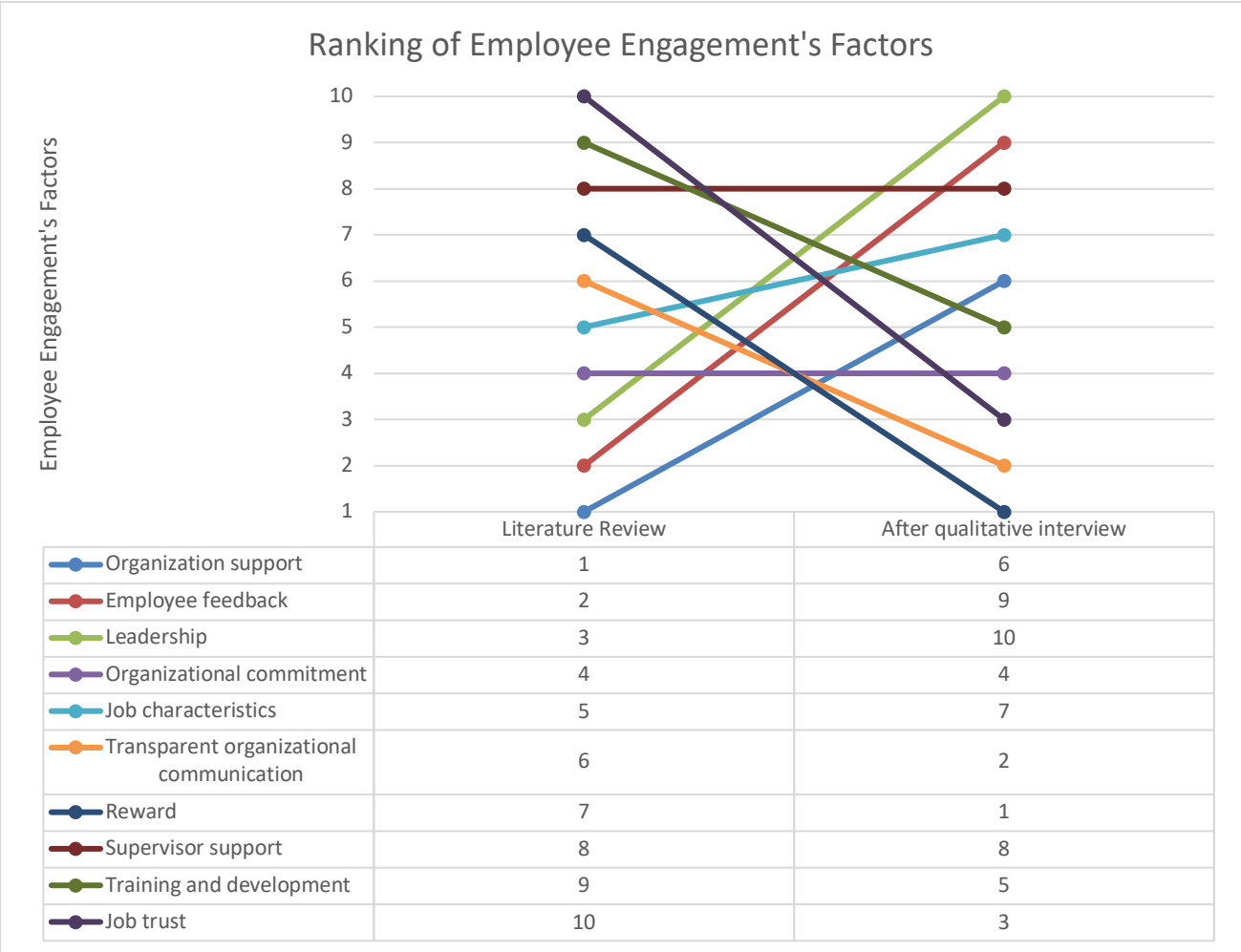

Fig. 3. Ranking of employee engagement after deductive thematic analysis

The summary of interviews shown in Table 6 outlines the main themes and insights obtained from IT experts about factors influencing employee engagement. By conducting semi-structured interviews, we identified eight significant aspects that contribute to a deep understanding of the factors that motivate employee engagement in the ICT industries.

Table 6
Summary of interview extracts on employee engagement

	No	Deductive thematic analysis	No of tag	Interview extracts
Employee engagement factors	1	Reward	20	P1: we can encourage them in the meeting say they are good job at this one. P5: Our reward and benefit are a little bit different because you're talking about how to motivate further, right, so that the staff get more engaged so you can share profit.
	2	Transparent organization communication	19	P1: Maybe we can use a zoom, or I also use some tools, for example the JIRA or Telegram to do the communications. P4: because all of us understand what each other are doing and we communicate like very frequently even though we are working from home.
	3	Job trust	15	P3: If they work from home and they didn't come office or sometimes they have to work in their country then we don't know, we cannot control their performance. P4: we just leave a message at a chat that says that OK, I'm away for 5 minutes, 10 minutes, be right back and if you need anything you know just keep it for 10 minutes.
	4	Organization commitment	12	P2: organization commitment is what I needed from my staff. P4: Just like employee response groups. You have teams who are in all the different sites from all the different sites, all the different regions they gather just because of a similar interest.
	5	Training and development	11	P2: they always have it in have to learn up the demand skill. P6: if the employee really shows their interest, I will say that most organization they will give the training or relevant resources to make sure that employee keep growing else if they are failing just take the money monthly salary and without any long term future.
	6	Organization support	10	P3: So, if client they encourage us to be work as a flexible hour, then we just follow. P5: we do offer incentives and organization support. We get very good support from the team as well
	7	Job characteristics	9	P2: currently especially for IT related one we can mostly be done over the offline or online.

			P6: as an IT person I can just do my job from my home or even from my favourite cafe or even from my favourite country or favourite hotel and I travel too somewhere.
8	Supervisor support	7	P2: we believe that a supervisor support quite good for the user. P6: Supervisor support provide us a good fallback
9	Employee feedback	5	P1: the employee can raise any issue in the weekly meeting. P4: Feedback about the job, say about the past or flexible Also can feedback anything they can feedback, It's quite transparent.
10	leadership	2	P4: leadership is quite ok.

In the application part of this study, we successfully identified and determined eight important factors that significantly impact employee engagement among IT professionals. Saks [28], Saks [68] has determined that organisational commitment is a result of employee engagement, not a cause of it. Therefore, it was not considered in this study. AI adoption and leadership were excluded because IT professionals mentioned it minimally during the interview sessions. The narrowed scope enables a more precise examination of the main factors influencing employee engagement in the ICT industry, guaranteeing that the study's results are pertinent and influential. These modifications improve the study's precision and significance, conforming to the methodological criteria necessary for the FDM.

3.3.2 Fuzzy Delphi steps

After gathering the expert questionnaire, we used the Fuzzy Delphi Method (FDM) to analyse the data, employing the FuzzyDelphiJmv module in Jamovi [78,79]. This approach enabled the gathering and improvement of expert viewpoints, guaranteeing a consensus on the significance and applicability of each element. Using fuzzy logic, we successfully managed the inherent uncertainties and subjective judgements present in the expert responses [61,80]. The utilisation of FuzzyDelphiJmv facilitated the analytic procedure [79], offering a resilient and methodical method to authenticate the identified elements of employee engagement and need satisfaction in the context of FWA among IT professionals in Malaysia.

4. Results

4.1 Interpretation of the Fuzzy Delphi Results

Fuzzy Delphi analysis on 69 items has successfully achieved the purpose, yielding compelling results. Cells highlighted indicate values of d more significant than 0.2, suggesting expert disagreement regarding the phrases assessed. Cells that are not coloured have a significantly higher quantity, indicating that most items are considered relevant in their perspectives. The research has determined that the member consensus percentage is over 75% and the defuzzification score for each item is more than 0.5. Using the defuzzification score, the ranking of each item can be calculated to determine their priorities. The defuzzification score can be utilised to calculate the ranking of each item, hence determining their priority. Calculating scores involves showcasing two elements that experts typically prefer: similarity inquiries that propose suggestions and provide positive comments. The employee engagement results from FDM are presented in Table 7 to Table 14. While, Table 15 to Table 17 display the FDM results for need satisfaction.

4.1.1 FDM result in employee engagement

Table 7
FDM result in reward

Reward	Item1	Item3	Item4	Item5
Expert 1	0.0200	0.4500	0.0900	0.0700
Expert 2	0.1500	0.0800	0.0900	0.1000
Expert 3	0.0200	0.0900	0.0700	0.0700
Expert 4	0.1200	0.0900	0.0900	0.1000
Expert 5	0.1500	0.0800	0.0900	0.1000
Expert 6	0.0200	0.0900	0.0700	0.0700
Expert 7	0.0200	0.0800	0.0700	0.0700
Expert 8	0.0200	0.0900	0.0900	0.1000
Expert 9	0.0200	0.0900	0.0700	0.0700
Expert 10	0.1200	0.1900	0.1700	0.0700
Value d of each item	0.0700	0.1300	0.0900	0.0800
Value d construct		0.09		
% of expert consensus for each item	100.0000	90.0000	100.0000	100.0000
% of expert consensus		97.50		
Defuzzification	0.8533	0.7800	0.8067	0.8133
Item ranking	1.0000	4.0000	3.0000	2.0000
New question number	Q1	Q4	Q3	Q2
Item Content	A pay rise	More freedom and opportunities	Respect from the people you work with	Praise from your supervisor

Table 8
FDM result in transparent organisation communication

Transparent organisation communication	Item1	Item2	Item3	Item4
Expert 1	0.0700	0.1000	0.0800	0.0300
Expert 2	0.0700	0.1000	0.0800	0.0300
Expert 3	0.1000	0.0700	0.0800	0.1300
Expert 4	0.1000	0.0700	0.0800	0.0300
Expert 5	0.1000	0.0700	0.0800	0.1300

Transparent organisation communication	Item1	Item2	Item3	Item4
Expert 6	0.1000	0.1000	0.0800	0.0300
Expert 7	0.0700	0.0700	0.0800	0.0300
Expert 8	0.0700	0.1000	0.0800	0.0300
Expert 9	0.0700	0.2500	0.0800	0.0300
Expert 10	0.0700	0.1000	0.0800	0.0300
Value d of each item	0.0800	0.1000	0.0800	0.0500
Value d construct		0.08		
% of expert consensus for each item	100.0000	90.0000	100.0000	100.0000
% of expert consensus		97.50		
Defuzzification	0.8133	0.7800	0.8000	0.8400
Item ranking	2.0000	4.0000	3.0000	1.0000
New question number	Q6	Q8	Q7	Q5
Item Content	My organisation provides information that is relevant to people like me.	My organisation provides information that is complete.	My organisation provides information that is easy for people like me to understand.	My organisation provides accurate information to people like me.

Table 9
FDM result in job trust

Job trust	Item2	Item3	Item4	Item5
Expert 1	0.0700	0.2400	0.1200	0.1000
Expert 2	0.0700	0.0600	0.0600	0.0700
Expert 3	0.0700	0.0600	0.2300	0.0700
Expert 4	0.1900	0.0600	0.4200	0.4400
Expert 5	0.0700	0.0600	0.0600	0.0700
Expert 6	0.2500	0.1100	0.1200	0.1000
Expert 7	0.1000	0.1100	0.1200	0.1000
Expert 8	0.1900	0.2000	0.1200	0.1000
Expert 9	0.0700	0.0600	0.1200	0.1000
Expert 10	0.1000	0.1100	0.1200	0.1000
Value d of each item	0.1200	0.1100	0.1500	0.1300
Value d construct		0.13		
% of expert consensus for each item	90.0000	80.0000	80.0000	90.0000
% of expert consensus for construct		85.00		

Job trust	Item2	Item3	Item4	Item5
Defuzzification	0.7800	0.7733	0.7533	0.7733
Item ranking	1.0000	3.0000	4.0000	2.0000
New question number	Q9	Q11	Q12	Q10
Item content	I feel my organisation is competent.	My organisation can be always trusted	I think my organisation treats me fairly.	My organisation is open and upfront with me.

Table 10
FDM result in training and development

	Item1	Item3	Item4
Expert 1	0.2300	0.1900	0.2700
Expert 2	0.0900	0.0600	0.1300
Expert 3	0.1200	0.1600	0.0800
Expert 4	0.4500	0.3600	0.4100
Expert 5	0.0900	0.0600	0.1300
Expert 6	0.1200	0.1900	0.0800
Expert 7	0.0900	0.1900	0.0800
Expert 8	0.2300	0.1900	0.2700
Expert 9	0.0900	0.1600	0.0800
Expert 10	0.1200	0.1600	0.0800
Value d of each item	0.1600	0.1700	0.1600
Value d construct		0.16	
% of expert consensus for each item	70.0000	90.0000	70.0000
% of expert consensus for construct		76.67	
Defuzzification	0.6467	0.6867	0.6067
Item ranking	2.0000	1.0000	3.0000
New question number	Q14	Q13	Q15

	Item1	Item3	Item4
Item content	My organisation provided enough training for me to achieve true performance.	The training improves my skills, knowledge, and attitude.	The training led me to be satisfied with my job.

Table 11
FDM result in organisation support

Organisation support				
	Item2	**Item4**	**Item6**	**Item7**
Expert 1	0.0400	0.0400	0.0700	0.0500
Expert 2	0.0400	0.0400	0.0900	0.1100
Expert 3	0.2200	0.2200	0.0900	0.1100
Expert 4	0.2200	0.0400	0.0900	0.0500
Expert 5	0.0400	0.2200	0.0900	0.1100
Expert 6	0.1300	0.1300	0.0700	0.0500
Expert 7	0.0400	0.0400	0.0900	0.0500
Expert 8	0.1300	0.1300	0.1700	0.0500
Expert 9	0.1300	0.1300	0.0700	0.0500
Expert 10	0.1300	0.1300	0.0700	0.0500
Value d of each item	0.1100	0.1100	0.0900	0.0700
Value d construct		0.10		
% of expert consensus for each item	80.0000	80.0000	100.0000	100.0000
% of expert consensus for construct		90.00		
Defuzzification	0.7467	0.7467	0.8067	0.8267
Item ranking	3.0000	4.0000	2.0000	1.0000
New question number	Q18	Q19	Q17	Q16

	Organisation support			
	Item2	**Item4**	**Item6**	**Item7**
Item content	My organisation strongly considers my goals and values	My organisation cares about my opinions	Help is available from my organisation when I have a problem.	My organisation would forgive an honest mistake on my part.

Table 12
FDM table in job characteristics

Job characteristics	Item2	Item3	Item5	Item6
Expert 1	0.1100	0.0300	0.1300	0.1500
Expert 2	0.0600	0.0300	0.0400	0.0500
Expert 3	0.0600	0.0300	0.0400	0.1900
Expert 4	0.0600	0.1300	0.1300	0.2400
Expert 5	0.2400	0.2200	0.2200	0.1900
Expert 6	0.1100	0.1300	0.1300	0.1500
Expert 7	0.2400	0.0300	0.0400	0.3900
Expert 8	0.1100	0.0300	0.0400	0.0500
Expert 9	0.1100	0.1300	0.2200	0.0500
Expert 10	0.2000	0.0300	0.1300	0.2400
Value d of each item	0.1300	0.0800	0.1100	0.1700
Value d construct		0.13		
% of expert consensus for each item	70.0000	90.0000	80.0000	70.0000
% of expert consensus for construct		77.5		
Defuzzification	0.7667	0.7533	0.7467	0.7200
Item ranking	1.0000	2.0000	3.0000	4.0000
New question number	Q20	Q21	Q22	Q23

Job characteristics	Item2	Item3	Item5	Item6
Item content	The degree to which the work I' m involved with is handled from beginning to end by myself.	The opportunity in my job to get to know other people.	The amount of variety in my job.	The control I have over the pace of my work.

Table 13
FDM results in supervisor support

Supervisor support	Item1	Item2	Item3
Expert 1	0.0700	0.0600	0.0400
Expert 2	0.1000	0.0600	0.0400
Expert 3	0.2800	0.0600	0.2000
Expert 4	0.0700	0.5600	0.4000
Expert 5	0.1000	0.0600	0.0400
Expert 6	0.0700	0.1200	0.1400
Expert 7	0.1000	0.1200	0.0400
Expert 8	0.0700	0.1200	0.1400
Expert 9	0.1600	0.2100	0.2300
Expert 10	0.1600	0.1200	0.1400
Value d of each item	0.1200	0.1500	0.1400
Value d construct		0.14	
% of expert consensus for each item	90.0000	80.0000	70.0000
% of expert consensus for construct		80.00	
Defuzzification	0.8067	0.7533	0.7333
Item ranking	1.0000	2.0000	3.0000
New question number	Q24	Q25	Q26

Supervisor support	Item1	Item2	Item3
Item content	My supervisor cares about my opinions.	My work supervisor really cares about my well-being.	My supervisor strongly considers my goals and values.

Table 14
FDM result in employee feedback

Employee feedback	Item1	Item2	Item3	Item4
Expert 1	0.1400	0.1900	0.2000	0.0700
Expert 2	0.0500	0.0200	0.0300	0.1000
Expert 3	0.0500	0.1900	0.2000	0.1000
Expert 4	0.4100	0.0200	0.0300	0.0700
Expert 5	0.0500	0.0200	0.0300	0.1000
Expert 6	0.1400	0.1600	0.1500	0.0700
Expert 7	0.1400	0.0200	0.0300	0.0700
Expert 8	0.1400	0.0200	0.1500	0.0700
Expert 9	0.1400	0.1600	0.1500	0.0700
Expert 10	0.2100	0.0200	0.0300	0.1000
Value d of each item	0.1400	0.0800	0.1000	0.0800
Value d construct		0.1		
% of expert consensus for each item	80.0000	100.0000	80.0000	100.0000
% of expert for construct		90.00		
Defuzzification	0.7400	0.7200	0.7333	0.8133
Item ranking	2.0000	4.0000	3.0000	1.0000
New question number	Q28	Q30	Q29	Q27
Item content	Proactive develop and make suggestions for issues that may influence the unit.	Proactively suggest new projects which are beneficial to work unit.	Proactively voice out constructive suggestions that help the unit reach its goals	Make constructive suggestions to improve the unit' s operation.

4.1.2 FDM result in need satisfaction

Table 15
FDM result in autonomy

Autonomy	Item3	Item5	Item6
Expert 1	0.0700	0.1700	0.0300
Expert 2	0.0900	0.1800	0.0300
Expert 3	0.2700	0.1800	0.0300
Expert 4	0.1700	0.1700	0.0300
Expert 5	0.0900	0.1800	0.2200
Expert 6	0.0700	0.1800	0.1300
Expert 7	0.0700	0.0500	0.0300
Expert 8	0.0900	0.0500	0.1300
Expert 9	0.0700	0.1700	0.1300
Expert 10	0.0700	0.1700	0.0300
Value d of each item	0.1100	0.1500	0.0800
Value d construct		0.11	
% of expert consensus for each item	90.0000	100.0000	90.0000
% of expert consensus for construct		93.33	
Defuzzification	0.8000	0.7067	0.7533
Item ranking	1.0000	3.0000	2.0000
New question number	Q31	Q33	Q32
Item content	I am free to express my ideas and opinions	I feel like I can pretty much be myself.	When I am at work, I must do what is assigned to me.

Table 16
FDM result in competence

Competence	Item2	Item3	Item4
Expert 1	0.1200	0.0700	0.1500
Expert 2	0.0500	0.0900	0.0500
Expert 3	0.0500	0.2700	0.1900
Expert 4	0.2200	0.0900	0.0500
Expert 5	0.0500	0.0900	0.0500

Competence	Item2	Item3	Item4
Expert 6	0.2200	0.0700	0.1900
Expert 7	0.0500	0.0700	0.3900
Expert 8	0.2200	0.1700	0.2400
Expert 9	0.1200	0.0700	0.1500
Expert 10	0.1200	0.0700	0.2400
Value d of each item	0.1200	0.1100	0.1700
Value of d construct		0.13	
% of expert consensus for each item	70.0000	90.0000	70.0000
% of expert consensus for construct		76.67	
Defuzzification	0.7533	0.8000	0.7200
Item ranking	2.0000	1.0000	3.0000
New question number	Q35	Q34	Q36
Item content	Supervisors at work tell me I am good at the working with my tasks.	I have been able to learn interesting and new skills at work.	Most days I feel a sense of accomplishment from working.

Table 17
FDM result in relatedness

Relatedness	Item1	Item4	Item7	Item8
Expert 1	0.4200	0.1500	0.0700	0.0300
Expert 2	0.0400	0.0600	0.0700	0.0300
Expert 3	0.0400	0.1500	0.0700	0.0300
Expert 4	0.1300	0.0600	0.1000	0.0300
Expert 5	0.0400	0.1500	0.0700	0.0300
Expert 6	0.1300	0.1500	0.2500	0.2200
Expert 7	0.1300	0.2000	0.1000	0.0300
Expert 8	0.0400	0.0600	0.1000	0.1300
Expert 9	0.0400	0.0600	0.1000	0.1300
Expert 10	0.1300	0.2000	0.1000	0.1300
Value d of each item	0.1100	0.1200	0.1000	0.0800
Value d construct		0.10		
% of expert consensus for each item	90.0000	80.0000	90.0000	90.0000
% of expert consensus for construct		87.50		

Relatedness	**Item1**	**Item4**	**Item7**	**Item8**
Defuzzification	0.7467	0.6800	0.7800	0.7533
Item ranking	3.0000	4.0000	1.0000	2.0000
New question number	Q39	Q40	Q37	Q38
Item content	I prefer my colleagues at work.	People at work care about me.	People at work are friendly toward me.	I got along with people in works.

4.2 *Summary of Reasons to Remove Items*

Examining the items connected with Employee Engagement and Need Satisfaction demonstrates a thorough method of assessing and eliminating items according to specific criteria in Table 18. A total of 49 initial items were examined for Employee Engagement, and therefore, 19 items were eliminated. The leading causes for removal were things that did not satisfy the required fuzzy score threshold. Specifically, 11 items were eliminated because they had more than three cells with a fuzzy score more than or equal to 0.20. In addition, six entries were excluded due to their d value percentages not meeting the minimum requirement of 75%. This statement demonstrates the importance of fuzzy scores and d value percentages in guaranteeing the dependability and lucidity of the remaining items.

Similarly, the Need Satisfaction construct, assessed through three variables, initially consisted of 20 questions, 10 of which were subsequently eliminated. The primary factors for removal were items that did not meet the 75% d value threshold, resulting in 6 removals, and items with defuzzification values below the α-cut value of 0.5, which led to 4 deletions. The rigorous filtering process highlights the significance of these criteria in preserving the accuracy and reliability of the measuring tools. In general, the analysis demonstrates a systematic strategy for improving the item sets, ensuring that the selected questions are strong and capable of effectively measuring the concepts of Employee Engagement and Need Satisfaction.

Table 18
Summary of reasons to remove items

Construct	**Factor**	**Number of initial items (items)**	**Reasons to remove (items)**			
			Percentages of d value for each item does not achieve 75%	More than 3 cells with fuzzy score ≥ 0.20	The defuzzification value for each item less than the α-cut value of 0.5	Total Items removed
Employee engagement	Reward	8	0	4	0	4
	Transparent organization communication	7	1	2	0	3
	Job trust	5	0	1	0	1

	Training and development	5	2	0	0	2
	Organization support	7	2	1	0	3
	Job characteristics	6	1	1	0	2
	Supervisor support	4	1	0	0	1
	Employee feedback	7	1	2	0	3
Need satisfaction	Autonomy	6	3	0	0	3
	Competence	6	1	0	2	3
	Relatedness	8	2	0	2	4
	Total	69	14	11	4	29

5. Conclusions

5.1 Summary of Key Findings

Table 19 discusses and summarises the use of the analysis. The Fuzzy Delphi approach was highly effective in categorising the modified collection of literature items into the study's dimensions, namely in the context of FWA. This approach demonstrates that employee involvement in the FWA setting is directly linked to achieving need satisfaction. The current study aligns with the effectiveness of earlier research studies that have applied FDM to verify and determine the relative importance of aspects related to the subject under investigation.

The examined items were accurately measured, as indicated by the average threshold $d \leq 0.2$ [75, 81] and the average attainment of specialist consensus for proximal employee engagement factors and consequences – need satisfaction, which is above 75% [82, 83]. The defuzzification score obtained for all things falls within the range of 0 to 1. The α-cut values, which are greater than 0.5, indicate that the confirmed items studied were considered acceptable and contributed to the body of knowledge [84, 85]. The comprehensive analytical results confirm that the study has successfully achieved its objectives of validating the assessment items for employee engagement and its consequences, specifically the need for satisfaction within the context of FWA.

Table 19
The modified number of items after the Fuzzy Delphi analysis

Construct	**Factor**	**Number of initial items (items)**	**Number of items (after analysis) (items)**	**Labelled questions**
Employee engagement	Reward	8	4	Q1 - Q4
	Transparent organization communication	7	4	Q5 – Q8
	Job trust	5	4	Q9 – Q12
	Training and development	5	3	Q13 – Q15
	Organization support	7	4	Q16 – Q19
	Job characteristics	6	4	Q20 – Q23
	Supervisor support	4	3	Q24 – Q26
	Employee feedback	7	4	Q27 – Q30
Need satisfaction	Autonomy	6	3	Q31 – Q33
	Competence	6	3	Q34 – Q36
	Relatedness	8	4	Q37 – Q40
	Total	69	40	

5.2 Implications for Practice

This study aims to improve understanding of employee engagement and need satisfaction in the ICT industry. It explores factors like artificial intelligence and regulatory frameworks using existing research. The research will provide insights into factors affecting IT professionals' engagement and adoption of FWA. The findings will benefit governmental bodies and the ICT industry, helping to develop plans for implementing FWA and developing work schedule schemes. The study's findings will refine the approach to FWA among IT professionals in Malaysia and serve as a blueprint for other sectors. Furthermore, manufacturing continues to be of greatest value, since NIMP 2030 seeks to promote growth driven by knowledge and enhance economic diversity throughout Malaysia [18, 19]. Other theoretical support for employee engagement in need satisfaction is derived from self-determination theory, where the discussed employee engagement factors are fulfilled and lead to IT professionals' basic psychological needs being met.

5.3 Limitations and Future Research

This study predominantly utilized cross-sectional designs, constraining the capacity to establish causal relationships. Subsequent research should use longitudinal designs to enhance comprehension of the evolving relationship dynamics between employee engagement and need satisfaction over time. Previous scholarly inquiries have frequently concentrated on the academic or knowledge-based industry, potentially constraining the applicability of the results. To improve the external validity of the findings, forthcoming studies should strive for more varied and inclusive samples.

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