Engineer Specific Job Demand Scale Development

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Abstract*: This research study was carried out with the aims to formulate new measuring, which focuses on the measuring of job demands in the context of engineer's job. The content of ESJD scale was validated via expert assessment using the Delphi Method (30 experts). Descriptive statistics, analysis factor with promax rotation, correlation analysis, linear regression analysis and one-way MANOVA test were used in this study to analyse the samples of registered engineers in Malaysia (N=504). The study showed satisfactory reliability and validity results for the new scale. The results of this study are expected to provide information to the management, administrators and organisational leaders in managing risks that affect the level of stress, psychological wellbeing and their impact on the level of professional commitment among engineers as well as the best method of implementing them.

***Index Terms*: Engineers, Job demand, Occupational stress, Psychological wellbeing**

I. INTRODUCTION

Parallel to meeting the needs of national and community development, engineering-related organisations and companies are required to work hand-in-hand in completing the aspirations of the people and nation. However, in the era of globalisation, engineering-related companies have to operate in a highly competitive open market with low profitability expectations, and even have to complete engineering projects on tight deadlines and faced with the constraints of very limited financial budget. Because of this, engineers as the main drivers of engineering-related companies are forced to face high job demands from management and clients, to continue to compete and further survive in business.

This has led to the occupational stress experienced by most engineers, following high job demands. Due to workload, many studies have reported cases of occupational stress experienced by engineers in various economic sectors (Bowen, Edwards, Lingard, & Cattell, 2014; Chen et al., 2011; De Silva, Samanmali, & De Silva, 2017). High workload and lack of salary and promotion prospects are among the two major contributory factors of occupational stress experienced by engineers (Yip & Rowlinson, 2009).

Revised Manuscript Received on May 05, 2019.
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Occupational stress experienced by engineers has become the subject of accumulated research (Hall et al., 2015; Ronen & Malach Pines, 2008). Concerns about the health effects of various stress relating to work, shortage of engineers and retrenchment among engineers have been highlighted in the national and global themes (e.g. Etzion, 1988; Keenan & Newton, 1985; Lingard, 2003; Rothmann & Malan, 2006).

One of the most frequently used theories is the job demands-resources theory, first introduced by Demerouti (2001) which is known as the JD-R model, and later improved and matured into the JD-R theory (Bakker & Demerouti, 2007, 2017). As detailed in the latest meta-analysis collection, the JD-R model has been used as part of the thousands of associations, and is used as part of the accurate size of research measurement (Alarcon, 2011; Bakker, Demerouti, & Sanz-Vergel, 2014; Crawford, LePine, & Rich, 2010; Nahrgang, Morgeson, & Hofmann, 2011).

According to Demerouti (2001), 'job demands' as demonstrated by the JD-R model and the determination of this investigation consideration refers to "the job aspects that require continuous physical or mental effort and are associated with certain physiological and psychological effects", for example; emotionally, has to work with customers or clients under high work pressure.

'Job demands' in the JD-R model is a unique predictor for health problems such as stress due to work and fatigue. However, psychological measurements for job demands in the JD-R model are highly generic, since there are additional job demands that are specific for certain job contexts. The use of generic job demands can affect prognostic quality (Bakker & Demerouti, 2017). Hence, it is said that the causes of occupational stress, in this case, job demands, need to be identified in the design of specific occupational characteristics based on specific context by the types of employment, as a way to develop a better understanding of the relationship between job demands and stress (Sparks & Cooper, 1999).

For example, jobs in the healthcare sector such as nurses are recorded as having certain job demands such as emotional demand related to 'illness and death', 'patient needs' and 'patient threats and violence' (Sundin, Hochwälder, & Bildt, 2008). Specific job demands in the context of entrepreneurial jobs have been found, such as emotional demands related to 'uncertainty and risk' (Dijkhuizen, Van Veldhoven, Schalk, & Schalk, 2014).

Engineers also have a particular job design for certain responsibilities, for example; applying engineering theory principles to engineering projects; performing detailed

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engineering calculations to build manufacturing, construction and installation standards; investigating client or public complaints; determining the nature and extent of the problem; recommending recovery measures, etc. (International Labor Office, 2012).

Therefore, this study has identified and developed a measurement scale of specific job demands for engineers, and subsequently compared the effects of job demands of ordinary occupations and engineer specific job demands, on the stress and psychological wellbeing associated with the work of an engineer.

To achieve that goal, we specifically address three goals: first, we identify, list down, develop and propose the occupational needs of specialised item engineers and ESJD measurement models based on comprehensive literary scans and expert opinions through Delphi techniques.

Second, we collect engineer researcher feedback data from various industries and gender background (N = 550). Random multistage sampling is used as a technique for determining samples. Third, we analyse the data. We conduct descriptive analysis to examine the data distribution.

We perform reliability checks to determine internal consistency of the measurements. We assess, discriminate and reduce measuring items, based on the suitability of items to measure using principal component analysis techniques.

Next, we test whether the ESJD measurement model is suitable for research data, using a valid factorial analysis method. We hypothesise that the ESJD measurement model has a satisfying level of goodness-of-fit with the research data. Lastly, we examine the relation of ESJD towards the stress with regard to job, and psychological wellbeing among engineers.

A. Measurement Scale Construction

In this phase, the objective of the study is to develop and validate the ESJD measurement scale. The findings of literary analysis (see Table 1) and interviews (see Table 2), the images that appear are the distinctive demands of engineers, with most demands focusing on cognitive, quantitative and emotional, and less on physical job demands.

Table. 1 Findings of the library analysis on the aspects of engineer specific job demands

No	Author	Scope of study	Finding
1	(P Bowen, Edwards, Lingard, & Cattell, 2014)	Examine the relationship between job demand, job control, workplace support, and pressure experience in the context of South Africa's construction investigated. N = 676 (architects, civil engineers, quantity surveyors, and project and construction managers).	Occupational stress is caused by 'work imbalance', 'need to prove oneself', 'working hours per week', 'working on tight deadlines', and support from line managers in difficult situations at work.
2	(K. Cattell, Bowen, & Edwards, 2016)	Identify and evaluate job demands, job controls and job support factors and to analyse based on gender and professional groups, both in terms of how the respondents consider it, as well as in terms of how often they experience it. N = 36 (architects, project managers, construction managers, engineers and quantity surveyors) in Cape Town, South Africa.	The highest factors in the demands are 'critical time constraints', 'workload' and 'inadequate rewards (salaries)'.
3	(De Silva et al., 2017)	Explore emphasis of specific professional jobs, their impact on profession and preventative strategies at the organisational level among construction professionals (project managers, engineers and quantity surveyors).	The identified job demands are 'project management pressure', 'client pressure' and 'installer weakness'.
4	(International Labor Office, 2012)	List down all the jobscope of work, the type of skills required and the information according to the tasks and tasks undertaken in the various occupational group classifications.	Demand on request are 'technical knowledge demand', 'problem solving demand', 'ethical & professionalism demand', 'client demand', 'supplier demand' and 'working in hazardous environment demand'.

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No	Author	Scope of study	Finding
5	(Kaufman, 1974)	Investigate the relationship of job challenge experienced by 85 engineers at the start of their career for their next job performance, professional contribution, and efficiency.	Engineers whose early work experience involves technical job challengers tend to contribute to a relatively early knowledge and to maintain a professional competence and good working performance during their career. For those with high technical capabilities, the initial challenge contributes to the professional and higher competence of their careers.
6	(Langdon & Sawang, 2018)	Investigate the main pressures in construction workplace	The results show that key pressures are 'time', 'personal finance' and 'solving technical problems demand'
7	(Board of Engineers Malaysia, 1967)	Formulate rules and guidelines as a measurable mechanism to regulate the conduct and ethics of those involved in engineering in Malaysia.	Engineers are required to carry out their noble, responsible, ethical and legal duties to fulfill their professional duties with due diligence, care and persistence. At all times hold the highest security, public health interests, and take reasonable steps to minimise the predictable adverse effects towards the environment.
8	(Lingard, 2003)	Explore the 'burnout' experience among engineers working in the Australian construction industry.	The relative importance of occupational characteristics rather than character traits in predicting combustion.
9	(Rahim & Siti-Rohaida, 2015)	Evaluate the level of individual wellbeing among Malaysian engineers who use career development goals as a predictor.	The development of career goals has a positive influence on the individual's wellbeing.
10	(Saleh & Desai, 1990)	This sample was used to test the relationship between each of three internal control variables, Type A behaviour, and job involvement, with occupational stress and job satisfaction of 249 male engineers from various organisations.	The results showed that Type A engineers experienced high levels of stress. However, recognition, behaviour and job involvement were all positively associated with satisfaction and in this case, bilateral interaction between validity and involvement and three-way interaction between the three variables were also found.
11	(Robinson, 2012)	Examine various tasks and activities planned by engineers, how their working time is distributed among them, and how these issues affect their satisfaction with their jobs.	The design engineer's work involves large technical engineering works (62.92% of the time) and socially social work (40.37% of the time).

Table. 2 Interview findings on specific job demands in the

No	Participant	Scope of research	Finding
1.	8 engineers size, age, gender and company sector are immaterial.	What are the challenge specific job demands and the hindrance specific job demands in the context of engineering job compared to other types of jobs.	Engineers' challenge specific job demands differ from ordinary workers' job demands which are mostly associated with the following areas: 'understanding technical & technological knowledge' and 'technical troubleshooting demand'. Engineers' hindrance specific job demands are 'client demand', 'supplier & installer demand' and 'working in a hazardous environment'. Other demands mentioned are: 'work imbalance' (workload), 'many tasks and roles' (role blur), and 'cognitive loads'.

Next, 40 question items were formed based on library analysis to measure engineer specific job demands. In this study, job demands were grouped and analysed in two types: namely, challenge job demands and hindrance job demands, as proposed in (Podsakoff et al., 2007; Van den Broeck et al., 2010). This was aimed to produce more specific measurements. The use of generic job demands can affect the quality of job stress measurement and prediction expectation of health problems associated with occupational stress (Bakker & Demerouti, 2017).

Then, content validation process for the proposed measurement items was done through Delphi's repeated consultation process with the experts. The Delphi's techniques are widely used in the context of social science research (Czinkota & Ronkainen, 1997; Keeney, Hasson, & McKenna, 2006; Yeh & Cheng, 2015), because this method can be used to investigate something that is yet to exist (Halal, Kull, & Leffmann, 1997; Rowe & Wright, 1999; Skulmoski & Hartman, 2007). Delphi participants in this study were consisted of N = 30 (experienced engineers = 16, engineering academicians = 13, psychometric = 1) who were not involved in the criterion validity phase. Participants were selected based on their knowledge and experience with regard to the issues being investigated. Academicians would be recognised whether they were senior lecturers or professors related to the topic studied, while engineers must have experience of at least 6 years and above in the industry.

The methodology, which was aimed at obtaining the level of agreement and criteria used for this study was based on the method adopted in some studies (Christie & Barela, 2005; Giannarou & Zervas, 2014; Hackett, Masson, & Phillips, 2006; Raskin, 1994; Rayens & Hahn, 2000). Data collection during the first round of consultation led to the establishment of consensus criteria among the panel members (see Table 3).

Table. 3 The main criteria in the definition of consensus for Delphi expert analysis

Consensus	Parameter
Agree	SD ≤ 1.5
	IQR ≤ 1
	Frequency [4-5] ≥ 51%
Disagree	SD ≤ 1.5
	IQR ≤ 1
	Frequency [1-3] ≥ 51%
Neutral	SD ≤ 1.5
	IQR ≤ 2
	MD ≥ 3.5

Note: SD = standard deviation, IQR= interquartile range, MD = Median

Our additional analytical strategies for Delphi study were the assessment of central tendency, and deployment measures; the level of consensus between rounds, namely Round 1 (R1) and Round 2 (R2), by validating the stability which was "the consistency of the answers between successful study rounds", by estimating "coefficient of variation difference" (Dajani, Sincoff, & Talley, 1979) and "F-Ratio" to compare item variations from two consecutive rounds, as well as the Pearson correlation coefficient for expert responses towards the items of two consecutive rounds. The stability parameter for the consensus level between R1 and R2 is shown in Table 4. The total number of items after being filtered through the Delphi study was 28 items to represent six dimensions. A total of 12 items were dropped from 40 original items.

Table. 4 Stability parameter for consensus level between Round R1 and Round R2

Delphi Consensus Question Item Stability	Parameter
Coefficient of Variation difference	C Vd ≈ 0
F-Ratio	F ≈ 1
Pearson correlation coefficient	r ≈ 1

Note: CVd = coefficient of variation difference; F = F-ratio; r = correlation coefficient

Next, 28 ESJD items were tested on face validity according to the criteria of the face validity analysis outlined by Davis (1992). Data analysis at this stage was aimed to evaluate ESJD question items presentation, whether the items in the instrument appear to be relevant, reasonable, unclear and not misleading. The results of the face validity analysis showed that the ESJD scale had recorded a satisfactory average percent agreement of clarity index and understanding, which exceeded the parameter level of 80% (average index 82.9%-92.2%). The overall results of the face validity analysis, indicate that the ESJD scale is understandable and has no confusion about the sentences produced.

For the purpose of the ESJD construct validity analysis and the subsequent analyses (linear regression analysis and SEM analysis), the study collected feedback from respondents involving 504 engineers registered with the Board of Engineers Malaysia in various industry sectors of various engineering disciplines. Respondents distribution by engineering disciplines is shown in Table 5.

Table. 5 Respondents distribution by engineering disciplines

Engineering Discipline	Frequency	Per cent
Civil Engineering	182	36.1
Electrical Engineering	78	15.5
Electronic Engineering	64	12.7
Mechanical Engineering	94	18.7
Chemical Engineering	43	8.5
Others	43	8.5
Total	504	100

It was discovered that respondents of civil engineering discipline recorded the highest frequency of 182 persons (36.1%), followed by respondents from mechanical engineering of 94 persons (18.7%), electrical engineering of 78 persons (15.5%), electronic engineering of 64 persons (12.7%), chemical engineering of 43 (8.5%) and others of 43 respondents (8.5%).

The results of distribution by discipline from a sample of 504 recorded a fairly equivalent figure compared to the composition of engineer population of 121,078 persons registered with the Board of Engineers Malaysia.

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This is because the actual distribution of population composition according to engineering disciplines were 33.6% of civil engineers, 22.7% of mechanical engineers, 15.71% of electric engineers, 10.9% of electronic engineers, 8% of chemical engineers and 9% are engineers of other engineering fields (“Board Of Engineers Malaysia,” n.d.). The findings of this study can be estimated as fair and square as the views from engineers of all engineering disciplines were gathered. Subsequently, the data from this study can be used for further reference and future research. Next, 28 items were tested for construct validity through factorial analysis.

II. FACTORIAL ANALYSIS

The first step was to identify the suitability of existing data to be used in factor analysis methods through Bartlett and Kaiser-Meyer-Olkin tests. Bartlett's test results on the ESJD scale recorded a significant value of < 0.5, while KaiserMeyerOlkin's sample sufficiency test recorded a value of 0.948, and these results surpassed the minimum parameter level suggested by Pallant (2016) of 0.6. Thus, the results of both tests support that the study data samples indicate the factorability of the correlation matrix. In other words, the study data can be used for the factorial analysis purposes.

Then, a factorial analysis was carried out using factor extraction and rotation. This step was done to extract variables and categorise them.

The initial factorial analysis conducted had presented six components with eigenvalues greater than 1, each explaining 42.2%, 18.2%, 6.1%, 5.3%, 4.9% and 4.4% of the variance, respectively. Using the Cattell test (1966), the study decided to retain all six components for further investigation.

Six component solutions explained a fraction of the total variance by the saved factor of 81, 21%, exceeding the recommended value of 50% (Streiner, 1994). A promax rotation was later carried out to build the components that can be understood. The rotated solution revealed the presence of simple structures (Thurstone, 1931), with all six components showing some strong loads and all variables were loaded significantly on only one component.

The results of the number of components to be retained were further validated by conducting a PA parallel test. In PA tests, component is rejected when the initial eigenvalue of extraction factor is found to be lower than the value of the corresponding PA analysis criteria for the randomly generated data matrix with the same size (28 variables x 504 respondents, 1000 recurrences) using Monte Carlo statistical software (Watkins, 2000). Based on the information about the size of eigenvalues, slopes changes and PA (see Table 6), six components were retained in the analysis.

Table. 6 The results of the eigenvalue of factor extraction analysis and parallel PA analysis

Number of Factor Component	Eigenvalue from factor extraction	Criterion value from PA	Result
C1	11.829	1.462	Retained
C2	5.105	1.395	Retained
C3	1.725	1.345	Retained
C4	1.471	1.302	Retained
C5	1.374	1.265	Retained
C6	1.234	1.230	Retained

The communal values of all retained items are above the recommended value of 0.3 as Pallant (2016) indicates that all saved items correspond to each other in the component. Six components are consisted of 28 items. The component factors: C1 represents 'ethical and responsibility demand', C2 represents 'working under pressure and hazardous environment demand', C3 represents 'master the technical knowledge demand', C4 represents 'problem solving demand', C5 represents 'client demand' and C6 represents 'supplier and installer demand'.

The findings of the matrix structural analysis of the factor extraction found that the factor components of C1, C3 and C4 were structured (loading factor above 0.5) and could be compiled as "challenge" specific job demands while the factor components of C2, C5 and C6 were structured (loading factor above 0.5 and would be collected as "hindrance" specific job demands (See Table 7).

Table. 7 Structure matrix Promax rotation factorial extraction

	Factor Component					
Item	C1	C2	C3	C4	C5	C6
S14	.866		.634	.553		
S10	.864		.650	.614		
S16	.863		.633	.562		
S12	.858		.589	.513		
S15	.844		.634	.579		
S13	.828		.561	.571		
S11	.788		.556	.531		
S5	.648		.901	.597		
S1	.639		.860	.605		
S4	.648		.860	.569		
S3	.645		.859	.585		
S2	.634		.850	.573		
S7	.593		.595	.882		
S8	.607		.596	.861		
S6	.575		.583	.853		
S9	.560		.554	.826		
S17		.504			.952	.468
S19		.463			.943	.414
S18		.476			.911	.412
S20		.578			.440	.956
S21		.577			.434	.956
S27		.871			.451	.496
S23		.859			.438	.535
S24		.858			.463	.512
S26		.855			.416	.487
S28		.847			.435	.547
S25		.819			.394	.460
S22		.579			.449	.953

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A. Analysis of similarities

Next, for the sample of this study (n = 504) the items extracted in factorial analysis were tested for similarities in measuring certain job demands, regardless of the differences in demographics (i.e. type of industry, years of service, gender and engineering discipline). MANOVA test and Leven homogeneity test were conducted to find a significant difference in variance and mean between the varied demographic groups mentioned above. The results of the similarity tests which are the Leven homogeneity test and the MANOVA test (see Table 7) showed that there was no significant difference between mean and variance between crossed industry, engineering discipline, gender and years of service ($p > 0.05$). This scale demonstrates the measurement capability that is not in favour of the varied demographic types specified.

Table. 8 Homogene Leven and MANOVA tests

Demography	Challenge Job Demand		Hindrance Job Demand	
	Homogeneity Leven Test (p-value)	One-Way MANOVA (p-value)	Homogeneity Leven Test (p-value)	One-Way MANOVA (p-value)
Gender	.447	.727	.198	.386
Type of Industry	.620	.827	.086	.852
Discipline	.768	.969	.519	.619
Years of Service	.976	.849	.710	.367

Note:
Gender : 1) Male 2) Female
Types of Industry: 1) Manufacturing 2) Construction 3) Oil & Gas 4) Public service 5) Aviation 6) Transportation & Logistic 7) Energy 8) Others
Discipline : 1) Civil Engineering 2) Electrical Engineering 3) Electronic Engineering 4) Mechanical Engineering 5) Chemical Engineering 6) Others
Years of Service : 1) 0-5 years, 2) 6-10 years 3) 10 years and above

B. Criterion Validity Analysis (Regression Analysis)

Next, the validity of the developed criterion scale was assessed. Based on the research hypothesis, this specific job demands of engineering have positive influence towards work-related stress and negative towards psychological wellbeing, and we estimated that the strength of the relationship far outweighed the relationship between ordinary job demands and psychological wellbeing and work-related stress. This predictive criterion validity analysis was based on the hypothesis statement of the study as stated in the following description.

Hypothesis 1: There is a more positive relationship between the level of 'hindrance' specific job demands and the work-related stress among engineers, as opposed to the level of ordinary job demands.

Hypothesis 2: There is a positive relationship between the level of 'challenge' specific job demands and the psychological wellbeing among engineers, similar to job resources.

In this study, job demands were gathered, distinguished and examined in two types: "challenge" job demands and "hindrance" job demands, as suggested in (Bakker & Sanz-Vergel, 2013; Cavanaugh, Boswell, Roehling, & Boudreau, 2000; Podsakoff et al., 2007; Tadić, Bakker, & Oerlemans, 2015; Van den Broeck, de Cuyper, de Witte, & Vansteenkiste, 2010). As stated in the study, "challenge" demands may be seen as "hindrance" demands, depending on the context of the occupation, and "challenge" demands were estimated to be positive for psychological wellbeing.

The findings of the correlation analysis were conducted on the study samples (n = 504), with the dimensions in the JD-R and ESJD models demonstrating strong relationships between the items of stress and psychological dimensions (see Table 24). The correlation between challenge specific job demands ($M = 2.69$, $SD = .80$) and psychological wellbeing ($M = 2.63$, $SD = .77$) showed a positive and moderately strong correlation, $r = .501$, $p < .01$. This is parallel to the job resources ($M = 2.69$, $SD = .79$) that was positively related to psychological wellbeing ($M = 2.63$, $SD = .77$) at the correlation of $r = .668$, $p < .01$. While hindrance specific job demands ($M = 2.66$, $SD = .77$) showed a more positive correlation value with occupational stress dimension ($M = 2.61$, $SD = .73$) at the correlation of $r = .585$, $p < .01$ as opposed to ordinary job demands ($M = 2.67$, $SD = .80$) at the correlation of $r = .467$, $p < .01$.

Table. 9 Inter correlations between 6 dimensions

		Intercorrelation					
		1	2	3	4	5	6
1	Challenge Job Demands	1	-.350**	-.444**	-.226**	.657**	.432**
2	Hindrance Job Demands	-.350**	1	.540**	.585**	-.501**	-.487**
3	Ordinary Job Demands	-.444**	.540**	1	.467**	-.492**	-.431**
4	Occupational Stress	-.226**	.585**	.467**	1	-.467**	-.438**
5	Psychological Wellbeing	.657**	-.501**	-.492**	-.467**	1	.668**
6	Job Resources	.432**	-.487**	-.431**	-.438**	.668**	1

Note : **p < .01

Multiple linear regression analysis was performed to investigate the relationship between the dimensions in the JD-R model based on the study hypotheses, and the ESJD scale (see Table 9 and Table 10 for results). The results of the data analysis using engineers sample, n = 504 by using the SPSS program significantly showed that challenge job demands and ordinary job demands were the predictive factors of occupational stress, where both of which predictive variables accounted for 37.4% changes of occupational stress variance [$R^2 = .374$, $F(2,501) = 149.79$, $p < .05$]. Analysis showed that predictive variables of hindrance job demands ($\beta = .47$, $\rho < .05$) recorded higher standard regression coefficients than ordinary job demands ($\beta = .21$, $\rho < .05$). Both predictive variables recorded a significant results of standard regression coefficient.

In addition, the results of multiple linear regression analysis for predictive variable of challenge job demands and ordinary job demands on psychological wellbeing significantly showed that challenge job demands recorded a significant β value ($\beta = .45$, $\rho < .05$) in the psychological wellbeing modelling equation, parallel to job resources ($\beta = -.47$, $\rho < .05$). Both predictive variables accounted for 61.4% change in psychological wellbeing variance [$R^2 = .614$, $F(2,501) = 397.65$, $p < .05$]. Both predictive variables recorded a significant results of standard regression coefficient. Overall, these results confirm hypothesis 1 and 2 of this research that there is a more positive relationship between the level of 'hindrance' specific job demands and work-related stress among engineers in Malaysia, as opposed to the level of ordinary job demands, and there is a positive relationship between the level of 'challenge' specific job demands and psychological wellbeing of engineers in Malaysia, similar to job resources.

Table. 10 ESJD multiple linear regression analysis on occupational stress

Independent variable	Psychological wellbeing
	(Standardised Beta)
Challenge Job Demands	.453
Job Resources	.472

Note: Responding variable : occupational stress

Table. 11 ESJD multiple linear regression analysis on psychological wellbeing

Independent variable	Occupational stress
	(Standardised Beta)
Hindrance Job Demands	.470
Ordinary Job Demands	.213

Note: Responding variable: psychological wellbeing

C. Reliability analysis

Next, a reliability analysis was carried out on the ESJD scale. Internal consistency and correlation between items of six indices are shown in Table 11. All six dimensions showed satisfactory internal consistency, Cronbach's alpha ranged from $\alpha = .92$ to $\alpha = .94$ and each index had a correlation between items that exceeded $r = .30$ (Hair , Black, Babin, & Anderson, 2010). The final items for the ESJD scale were consisted of 28 items as listed in Appendix A.

Table. 12 Number of items (n), correlation between items and Cronbach's Alpha (α) of six dimensions

Dimension	n	Correlation between items (r)	α
Master the technical knowledge demand	5	0.72 - 0.77	0.94
Problem solving demand	4	0.69 - 0.76	0.92
Ethical and responsibility demand	7	0.67 – 0.76	0.94
Client demand	3	0.89 – 0.89	0.95
Installer and supplier demand	3	0.91	0.96
Working under pressure and hazardous working environment demand	6	0.68 – 0.74	0.94

The findings of the ESJD scale development analysis suggest that the ESJD scale is a measurement instrument that has satisfactory levels of validity and reliability for measuring specific job demands in the context of an engineer's job.

III. CONCLUSION

Table 17 shows the findings summary of this study.

Table. 17 Results summary of the whole analyses

RESULTS OF THE ESJD SCALE DEVELOPMENT ANALYSIS	
ACTIVITY	RESULT
Development of scale draft	40 items were developed for measuring 3 dimensions of hindrance specific job demands and 3 dimensions of challenge specific job demands.
Delphi content validity analysis	28 items were retained and 12 items were dropped from 40 original items.
Face validity analysis	28 items were retained.
Factorial analysis	28 items were retained. 6 sub-factors (dimensions) formed 2 main factors, namely (challenge specific job demands and hindrance specific job demands).

Equality analysis	The ESJD scale did not show any differences in the variance results on different groups of demographics (gender, type of industry, years of service, engineering discipline)
Criterion validity analysis	- Challenge specific job demands recorded more positive relationship strengths towards occupational stress than ordinary job demands. - Challenge specific job demands recorded the strength of a positive relationship towards the psychological wellbeing parallel to job resources.
Reliability analysis	All six dimensions showed satisfactory internal consistency, Cronbach's alpha ranging from .92 to .94.

Among the main purposes of the study was to develop and validate new tools in measuring job demands; that is, Engineer Specific Job Demand (ESJD), which focuses on measuring specific job demands in the context of engineering jobs. In the early stage which was the exploratory phase, we identified the scope of engineer specific job demands to be measured which produced six dimensions: 'technical knowledge demand', 'problem solving demand', 'ethical and responsibility demand',' client demand', 'supplier and installer demand' and 'working under pressure and hazardous working environment demand'.

Based on that, 40 draft items have been constructed and formulated. The scale draft was then evaluated and analysed through two Delphi studies and face validity study that produced 28 items. This 28-item ESJD scale was then verified for its reliability and consistency through construct validity analysis, compatibility test, criterion validity analysis and internal consistency analysis, involving respondents of n = 504 of registered engineers.

The findings of the ESJD scale development analysis suggested that the ESJD scale is a measurement instrument that has a satisfactory level of validity and reliability to measure specific job demands for the context of an engineer's job.

ACKNOWLEDGEMENT

This material is based upon work supported by the Universiti Kebangsaan Malaysia under Grant No. KK-2018-013. We would like to show our gratitude to the Mohd Awang Idris of University Malaya for sharing his pearls of wisdom with us during the course of this research, and we thank 2 “anonymous” reviewers for their so-called insights.

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