Journal of Fundamental and Applied Sciences

ISSN 1112-9867

Available online at http://www.jfas.info

Research Article

Special Issue

MECHANICAL ENGINEERS AND PROFESSIONAL SKILLS: GENERIC SKILLS AND SOFT SKILLS MODEL STUDIED

W. O. A. S. Wan Ismail[1,*] and N. Hamzah[2]

[1]Faculty of Innovation Design and Technology, Universiti Sultan Zainal Abidin, Gong Badak, Kuala Terengganu, Terengganu, Malaysia

[2]Faculty of Engineering and Built Environment, National University of Malaysia, Bangi, Selangor, Malaysia

Published online: 01 February 2018

ABSTRACT

Professional Skills is a basic component to the production of labor. Hence, through this study, two models have been identified namely Generic Skills Model and Soft Skills Model. It is used throughout the study to see the extent of its needs in producing competitive Mechanical Engineers. The objectives of this study are studying the level of need for Generic Skill elements in producing Mechanical Engineers, studying the level of need for the Soft Skills element in producing Mechanical Engineers and see the significant relationship between the elements of Generic Skills and Soft Skills. The data obtained was processed using the XL-Stat 2014 software for Discriminant Analysis (DA) to answer the research questions. This study involved 300 respondents from industrial areas in Peninsular Malaysia.

Keywords: mechanical engineers; professional skills; generic skills; soft skills; discriminant analysis.

Author Correspondence, e-mail: woaswi6467@gmail.com

doi: http://dx.doi.org/10.4314/jfas.v10i2s.22

Journal of Fundamental and Applied Sciences is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License. Libraries Resource Directory. We are listed under Research Associations category.

1. INTRODUCTION

1.1. Professional Skills

Engineering can be define as a profession that seeks individual skills and knowledge based on the knowledge of Mathematics, Science and Technology as well as subjects related to business and management [1]. It is largely empirical with some of the concepts and skills imported from various disciplines of engineering [1-2] and in the formation of professional Skills. The development of professional skills is aimed at achieving cost savings and improving industry performance, [3] industrial needs and the country social needs [4].

In today's circulation of technology, it demanded that each of the graduates have Professional Skills. This is a skill that must be mastered in producing a mechanical engineer in particular. Modern engineering graduates need to be skillful in every aspect of soft skills and generic skills if they wish to successfully do their job [5] as best they can. In order to see how far it is needed, the researchers have used the following two models throughout the study.

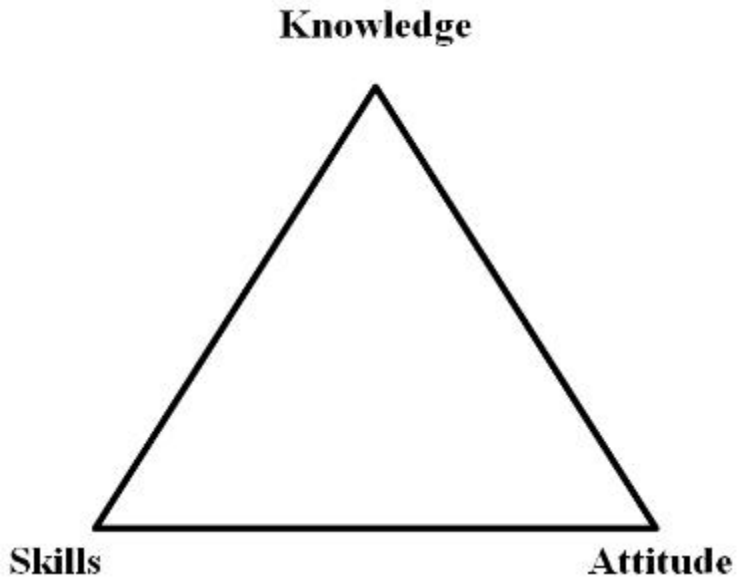

Fig.1. Generic skills model

Fig. 1 shows the Generic Skills Model involving three elements namely Knowledge, Skills and Attitude [6]. This is a fundamental model in the search for a new workforce by industry [7] in all areas including engineering. It aims to identify the strength of controlled elements in engineering field.

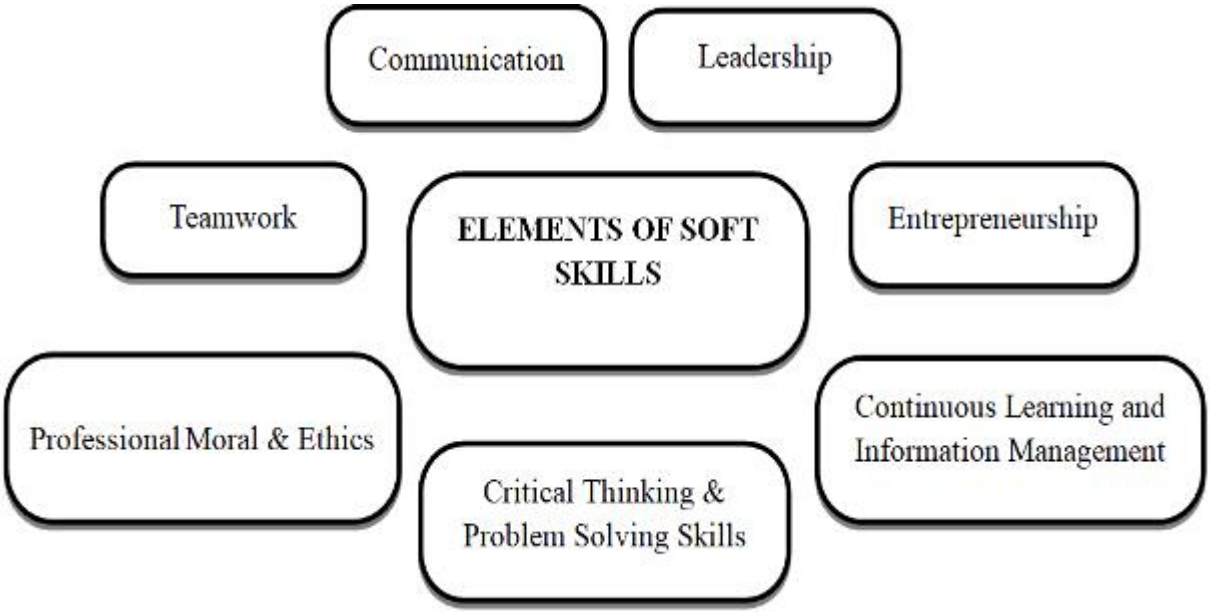

Fig.2. Soft skills model

Fig. 2 shows the Soft Skills Model involving seven elements such as Communication, Leadership, Entrepreneurship, Continuous Learning and Information Management, Critical Thinking and Problem Solving, Professional Moral and Ethics and Teamwork. Soft Skills are a key requirement established by various parties [8] to help increase the capabilities of a company [9]. This skill is also a valuable asset for every employee at all levels [10] in business and the competitiveness of industry.

It is important to emphasis including critical thinking and problem solving, knowledge building, competence in procedures [11] embracing soft skills involving communication, teamwork and self-learning [12] students. These two elements are indispensable and studies are conducted to see the most dominant elements required by the industry and employers towards Mechanical Engineers.

2. RESULTS AND DISCUSSION

The researcher conducted a study on respondents who have been identified. Any percentage value that shows 80.6% above is at level five (very high needs). Here are the findings that have been obtained.

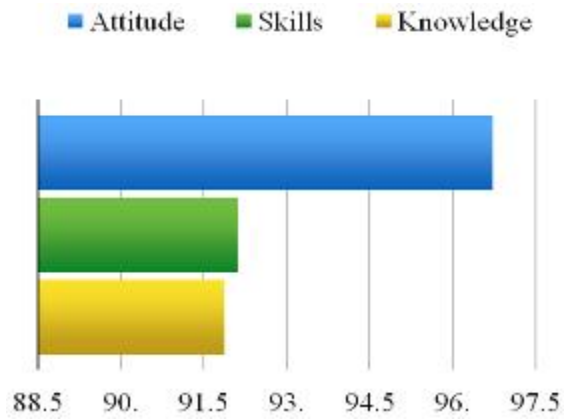

Fig.3. Histogram summary of the requirements mechanical engineer's generic skills

The order for each element is shown in Fig. 3. The three elements shown the percentage value is at a very high level of need. However, the most dominant Generic Skill is needed based on the study and respondents' answers (Attitude). A Mechanical Engineer should practice a respectable attitude in their daily work practices. Superior personalities will create favorable professional attitudes [13]. At the same time, it will illustrate the formation of good attitudes among graduates [14] and workers under the supervision of Mechanical Engineers.

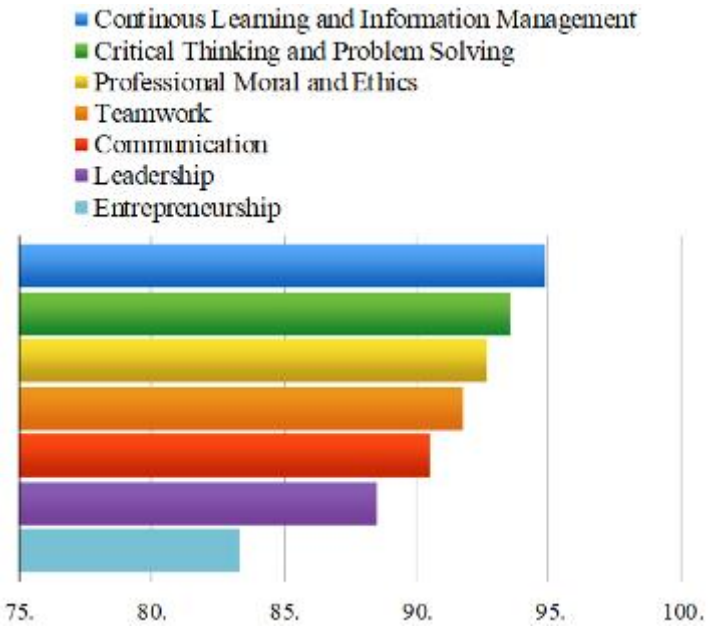

Fig.4. Histogram summary of the requirements of mechanical engineer's soft skills

The priority order of each element is shown in Fig. 4. The seven elements indicate the percentage value is at a very high level of need. However, the most dominant Soft Skills required based on the research and respondents' answers are Continuous Learning and

Information Management. The orientation of any information and continuous learning takes place in a person's cognitive and affective domain [15]. So, each of the Mechanical Engineers should embrace this element as it affects the practice and the daily work potential in producing competitive Mechanical Engineers. Lifelong learning is essential for sustainable development [16] even continuous learning is a process for improving skills and knowledge, civics and even social [17] in the global world today.

Table 1. Standard Testing Wilks' Lambda (Rao estimation)

Criteria	Value
p-value	< 0.0001
alpha	0.05

Table 1 shows the set of values that needed to be fulfilled in Discriminant Analysis (DA) before ensuring that any hypotheses are accepted or rejected. The purpose of this is to make a hypothesis finding accurately based on the variables determined by the researcher. Interpretation of Test referred to in explaining the acceptance or rejection of any H0 or Ha is as follows.

H0: Vector mean of all classes is equal

Ha: At least one mean vector is different from the other

Based on the analysis, the resulting p-value is lower than the significant level of alpha = 0.05. Therefore, H0 null hypothesis is accepted and Ha hypothesis is rejected. The risk of rejecting the H0 null hypothesis is when the accuracy is lower than 0.01%.

2.1. Null Hypothesis and Alternatives

2.1.1. Hypothesis 1

Table 2. Standard Testing Wilks' Lambda (Rao estimation)

i		ii	
Criteria	**Value**	**Criteria**	**Value**
Lambda	0.033	Lambda	0.012
F (Observed value)	34.671	F (Observed value)	62.040
F (Critical value)	1.325	F (Critical value)	1.325
DF1	68	DF1	68
DF2	528	DF2	528
p-value	< 0.0001	p-value	< 0.0001
alpha	0.05	alpha	0.05
iii		iv	
Criteria	**Value**	**Criteria**	**Value**
Lambda	0.051	Lambda	0.007
F (Observed value)	26.527	F (Observed value)	84.194
F (Critical value)	1.325	F (Critical value)	1.325
DF1	68	DF1	68
DF2	528	DF2	528
p-value	< 0.0001	p-value	< 0.0001
alpha	0.05	alpha	0.05
v			
Criteria	**Value**		
Lambda	0.000		
F (Observed value)	99.438		
F (Critical value)	1.261		
DF1	102		
DF2	788		
p-value	< 0.0001		

alpha	0.05

Based on Table 2 i-v find that H0: The mean vectors of the five items are the same. This means the null hypothesis is accepted and the alternative hypothesis is rejected.

Table 3. Standard Testing Wilks' Lambda (Rao estimation)

Hypothesis	Research Findings
Null Hypothesis: There is no significant linear relationship between the elements of Generic Skills (Knowledge) and the Soft Skills in the production of the Mechanical Engineering workforce.	Hypothesis Accepted.
Alternative Hypothesis: There is a significant positive linear relationship between the elements of Generic Skills (Knowledge) and the Soft Skills in the production of the mechanical engineering workforce.	Hypothesis Rejected.

Hence, there is a no significant linear relationship between the elements of Generic Skills (Knowledge) and the Soft Skills in the production of the Mechanical Engineering workforce. If (Knowledge) held by a mechanical engineer at the high level, it does not guarantee the level heights of the Soft Skills to be owned by them. In other words, Generic Skills (Knowledge) does not affect Soft Skills at all in the production of mechanical engineering workforce.

2.1.2. Hypothesis 2

Table 4. Standard Testing Wilks' Lambda (Rao estimation)

i		ii	
Criteria	**Value**	**Criteria**	**Value**
Lambda	0.002	Lambda	0.028
F (Observed value)	51.459	F (Observed value)	38.990
F (Critical value)	1.261	F (Critical value)	1.325
DF1	102	DF1	68
DF2	788	DF2	528
p-value	< 0.0001	p-value	< 0.0001
alpha	0.05	alpha	0.05
iii		iv	
Criteria	**Value**	**Criteria**	**Value**
Lambda	0.071	Lambda	0.044
F (Observed value)	21.417	F (Observed value)	29.392
F (Critical value)	1.325	F (Critical value)	1.325
DF1	68	DF1	68
DF2	528	DF2	528
p-value	< 0.0001	p-value	< 0.0001
alpha	0.05	alpha	0.05
v		vi	
Criteria	**Value**	**Criteria**	**Value**
Lambda	0.031	Lambda	0.030
F (Observed value)	36.222	F (Observed value)	36.801
F (Critical value)	1.325	F (Critical value)	1.325
DF1	68	DF1	68

DF2	528	DF2	528
p-value	< 0.0001	p-value	< 0.0001
alpha	0.05	alpha	0.05

Based on Table 4 i-vi, H0: The mean vectors of the six classes are the same and this means the null hypothesis is accepted and the alternative hypothesis is rejected.

Table 5. Standard Testing Wilks' Lambda (Rao estimation)

Hypothesis	Research Findings
Null Hypothesis: There is no significant linear relationship between the elements of Generic Skills (Skills) and Soft Skills in the production of the mechanical engineering workforce.	Hypothesis Accepted
Alternative Hypothesis: There is a significant positive linear relationship between the elements of Generic Skills (Skills) and Soft Skills in the production of the Mechanical Engineering workforce.	Hypothesis Rejected

Therefore, there is a no significant linear relationship between the elements of Generic Skills (Skills) and the Soft Skills in the production of the Mechanical Engineering workforce. If (Skills) held by a mechanical engineer at the high level, it does not guarantee the level heights of the Soft Skills to be owned by them. In other words, Generic Skills (Skills) does not affect Soft Skills at all in the production of mechanical engineering workforce.

2.1.3. Hypothesis 3

Table 6. Standard Testing Wilks' Lambda (Rao estimation)

i		ii	
Criteria	**Value**	**Criteria**	**Value**
Lambda	0.123	Lambda	0.035
F (Observed value)	14.396	F (Observed value)	33.899
F (Critical value)	1.325	F (Critical value)	1.325
DF1	68	DF1	68
DF2	528	DF2	528
p-value	< 0.0001	p-value	< 0.0001
alpha	0.05	alpha	0.05
iii		iv	
Criteria	**Value**	**Criteria**	**Value**
Lambda	0.073	Lambda	0.005
F (Observed value)	21.042	F (Observed value)	98.561
F (Critical value)	1.325	F (Critical value)	1.325
DF1	68	DF1	68
DF2	528	DF2	528
p-value	< 0.0001	p-value	< 0.0001
alpha	0.05	alpha	0.05
v		vi	
Criteria	**Value**	**Criteria**	**Value**
Lambda	0.010	Lambda	0.293
F (Observed value)	71.427	F (Observed value)	18.795
F (Critical value)	1.325	F (Critical value)	1.474
DF1	68	DF1	34
DF2	528	DF2	265

p-value	< 0.0001	p-value	< 0.0001
alpha	0.05	alpha	0.05

Based on Table 6 i-vi find that H0: The mean vector of the six classes is the same. This means that the null hypothesis is accepted and the alternative hypothesis is rejected.

Table 7. Standard Testing Wilks' Lambda (Rao estimation)

Hypothesis	Research Findings
Null Hypothesis: There is no significant linear relationship between the elements of Generic Skills (Attitude) and Soft Skills in the production of the mechanical engineering workforce.	Hypothesis Accepted
Alternative Hypothesis: There is a significant positive linear relationship between the elements of Generic Skills (Attitude) and Soft Skills in the production of the mechanical engineering workforce.	Hypothesis Rejected

Therefore, there is a no significant linear relationship between the elements of Generic Skills (Attitude) and Soft Skills in the production of the mechanical engineering workforce. If (Attitude) held by a mechanical engineer at the high level, it does not guarantee the level heights of the Soft Skills to be owned by them. In other words, Generic Skills (Attitude) does not affect Soft Skills at all in the production of mechanical engineering workforce.

Table 8. Standard Testing Wilks' Lambda (Rao estimation)

Hypothesis	Research Findings
Null Hypothesis: There is no significant linear relationship between the elements of Generic Skills (KG) and the Soft Skills (KI) in the production of the mechanical engineering workforce.	Hypothesis Accepted
Alternatives Hypothesis: There is a significant positive linear relationship between the Generic Skill (KG) and the Soft Skills (KI) in the production of the mechanical engineering workforce.	Hypothesis Rejected

In conclusion, based on the findings found in Table 8, there is a no significant linear relationship between Generic Skill and Soft Skills in the production of the Mechanical Engineering workforce. The results of the hypothesis shows that, if Generic Skills held by a mechanical engineer at the high level, it does not guarantee the level heights of the Soft Skills to be owned by them. In other words, Generic Skills does not affect Soft Skills at all in the production of mechanical engineering workforce.

3. METHODOLOGY

Questionnaires were initially distributed to respondents. This study uses quantitative methods involving industrial areas throughout Peninsular Malaysia that carry out Mechanical and Manufacturing Engineering activities. Random Samples were used to get the population at the beginning of the study. A total of 1384 respondents had responded to the questionnaire submitted. Out of these 1384 respondents, a total of 300 samples were selected [18] randomly selected to process data.

The XLStat 2014 software is used to process raw data collected. Discriminant Analysis (DA) is used to achieve objectives and to answer the research questions. Percentage reading was applied [19] throughout the study.

Table 9. Percentage classification of labor requirement level [20]

Formula	Percentage	Level	Justification
100 - 1 / 5 = 19.8	80.6 - 100	Five	Very High
	60.7 - 80.5	Four	High
	40.8 - 60.6	Three	Medium
	20.9 - 40.7	Two	Low
	1.00 - 20.8	One	Very Low

The percentage used in this study is divided into five main categories involving 80.6 - 100 (Very High Needs / Very High Fulfilled), 60.7 - 80.5 (High Needs / High Satisfactory), 40.8 - 60.6 (Medium Requirement / Medium Satisfied), 20.9 - 40.7 (Low Needs / Low Satisfactory) and 1.00 - 20.8 (Very Low Needs / Very Low Satisfactory).

4. CONCLUSION

In conclusion, the priority element of producing Mechanical Engineer's workforce is shown in Fig. 5. For the Generic Skills Model, Attitude is the most essential element in terms of skills and knowledge. For the Soft Skills Model, Continuous Learning and Information Management takes precedence over the highest level of need. All elements are at a very high level of need, but there are still differences in terms of percentage between one element and another.

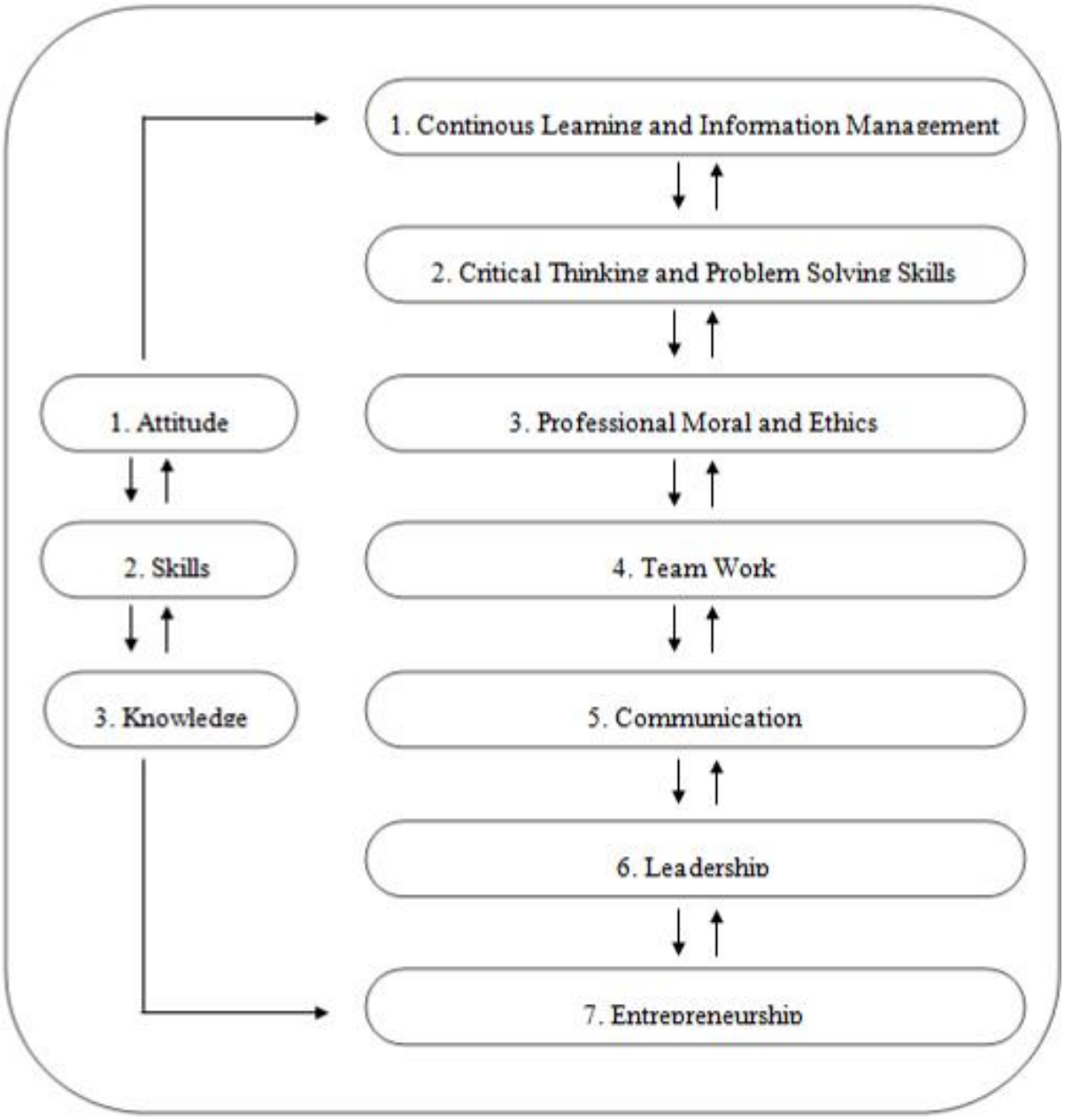

Fig.5. Priority model element of producing a competitive mechanical engineer

5. ACKNOWLEDGEMENTS

Special thanks to Faculty of Innovative Design and Technology, Universiti Sultan Zainal Abidin (UniSZA), Faculty of Engineering and Built Environment, National University of Malaysia (UKM) and Ministry of Higher Education (MoHE).

6. REFERENCES

[1] Shoji S. New waves of engineering education and IEA's graduate attributes. 2013,

www.jabee.org/public_doc/download/?docid=1590

[2] Kermit V. E. Aeronautical engineering: Encyclopedia Americana. New York: Scholastic Corporation, 2015

[3] Seri B M, Saemah R, Seri I M, Mohd Y H. Persepsi pelajar kejuruteraan terhadap persekitaran pembelajaran. In International Conference on Research in Islamic Education and Arabic Language, 2012

[4] Hassan S N, Zamberi M M, Khalil S N, Sanusi N, Wasbari F, Kamarolzaman A A. Company perception on the employability skills of industrial training students. Journal of Technical Education and Training, 2013, 4(2):1-8

[5] Kakepoto I, Omar N A, Boon Y, Iqbal S Z. Perspectives on oral communication skills for engineers in engineering profession of Pakistan. International Journal of Applied Linguistics and English Literature, 2012, 1(5):176-83

[6] Kahn L, McNeil B, Patrick R, Sellick V, Thompson K, Walsh L. Developing skills for life and work: Accelerating social and emotional learning across South Australia. Adelaide: Australian Centre for Social Innovation and the Foundation for Young Australians, 2012

[7] Department of Occupational Standards (DOS). Bhutan vocational qualifications framework. Bhutan: Ministry of Labour and Human Resources, 2013

[8] Wasimudin S S. Vocational technology education students' perception on employability skills. In 2nd UPI International Conference on Technical and Vocational Education and Training, 2012

[9] Anderson C, Gantz JF. Skill requirements for tomorrow's best jobs: Helping educators provide students with skills and tools they need (Whitepaper). IDC Analyze the Future, 2013

[10] Mishar D S. Engineering employability skills required by employers in India. International Research Journal of Engineering and Technology, 2016, 3(2):961-963

[11] Rahman R A, Yusof Y M, Kashefi H, Baharun S. Developing mathematical communication skills of engineering students. Procedia-Social and Behavioral Sciences, 2012, 46:5541-5547

[12] Plumblee J M, Cattano C, Bell L, Klotz L. Fulfilling engineering program objectives through service learning campaigns in developing countries. Leadership and Management in Engineering, 2012, 12(2):46-52

[13] Etuk A B, Usoro A D. Technical Vocational Education and Training (TVET) teacher quality and self-efficacy of TVET Students (A case study College of Education, South-South-Nigeria). International Journal of Educational Benchmark, 1(1):94-104

[14] Alias M, Lashari T A, Akasah Z A, Kesot M J. Translating theory into practice: Integrating the affective and cognitive learning dimensions for effective instruction in engineering education. European Journal of Engineering Education, 2014, 39(2):212-232

[15] De Haan E, Duckworth A. Signalling a new trend in executive coaching outcome research. International Coaching Psychology Review, 2013, 8(1):6-19

[16] Afeti G, Adubra AL. Lifelong technical and vocational skills development for sustainable socioeconomic growth in Africa. Synthesis Paper-Sub-Theme 2. In Triennale on Education and Training in Africa, 2012, pp. 12-17

[17] Maringa M. Proposed interventions for the technical industrial and vocational enterprise training (TIVET) sector in Kenya. Journal of Technical Education and Training, 2014, 6(1):89-120

[18] Krejcie R V, Morgan D W. Determining sample size for research activities. Educational and Psychological Measurement, 1970, 30(3):607-610

[19] Mohd Y. I. Sembang santai penyelidikan. Terengganu: Firdaus Press Sdn. Bhd., 2017

[20] Likert R. A technique for the measurement of attitudes. New York: The Science Press, 1932

How to cite this article:
Wan Ismail W O A S, Hamzah N. Mechanical engineers and professional skills: generic skills and soft skills model studied. J. Fundam. Appl. Sci., 2018, *10(2S), 284-299.*