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GENERIC SKILLS REQUIREMENTS (KSA MODEL) TOWARDS FUTURE MECHANICAL ENGINEERS USING DISCRIMINANT ANALYSIS

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ABSTRACT

Generic Skills is a basic requirement that engineers need to master in all areas of Engineering. This study was conducted throughout the peninsular Malaysia involving small, medium and heavy industries using the KSA Model. The objectives of this study are studying the level of requirement of Generic Skills that need to be mastered in order to become a competitive Mechanical Engineer and identifying the most dominant Generic Skills required by the industry/employer towards the future of the Mechanical Engineer. The set of questionnaires distributed to respondents was analyzed using software XLSTAT2014 software to obtain Descriptive Statistics and Discriminant Analysis (DA) as required to achieve the objective of the study. This study will guide all future engineers, especially in the field of Mechanical Engineering in Malaysia to penetrate the job market according to the current market needs.

Keywords: generic skills; KSA model; mechanical engineers; discriminant analysis.

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1. INTRODUCTION

1.1. Generic Skills

Career as an Engineer is very challenging. There are some students who follow the Engineering field but fail to practice it. They only learn it in order to pass the exam. Students basically receive education from primary to university oriented exams and the long-term effects of it makes the students less interested in learning and gaining professional knowledge. Besides that, they do not have the motivation to explore any power of knowledge [1]. One study found that 90% of the teachers believe that positive effects can not only be seen from behavioral change but more than that which are the elements of their knowledge, skills and attitudes also respond to creating changes in their lives and careers [2].

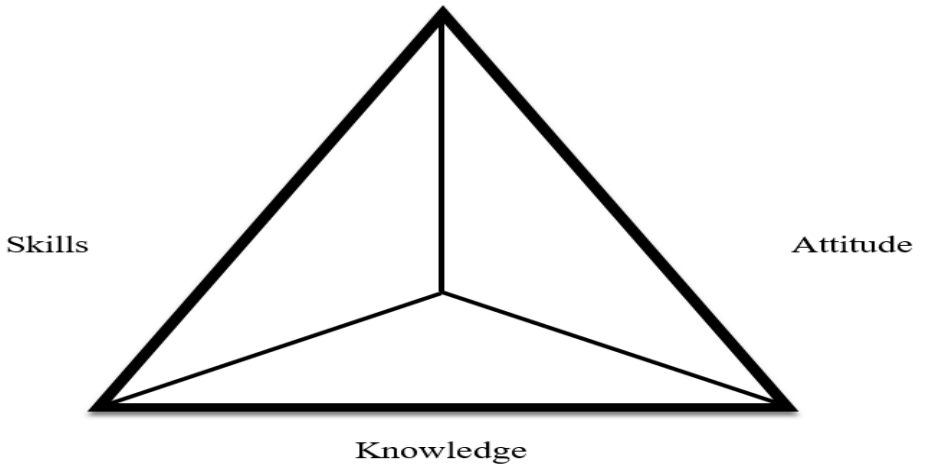

Fig.1. Workforce model

Knowledge, Skills and Attitudes (KSA) are taken as a fundamental model in hiring a new workforce or in the engineering education process. It aims to identify the strength of controlled elements in Engineering. The main contribution of these elements is to be able to see new perspectives that reflect the hope of shaping future professionalism.

Knowledge in engineering or technical is recognized upon reaching satisfactory level in the areas of expertise related to Mathematics, Science, Experimental analysis, current engineering knowledge/technology tools and technology knowledge [3]. Skills are defined as the ability to perform the tasks given using existing knowledge [4]. While, attitude can be divided into two main groups which includes personal and professional [5].

Today, demand for graduates in engineering and technology is increasingly in line with the current industrial developments in the world and particularly in Malaysia. 'Engineers in 2020s' are expected to have strong technical and social skills based on knowledge, skills and attitudes that will enable a creative problem solving [6], capable of utilizing knowledge and

skills to solve specific problems arising in real professional situations and activities [7-10]. The expectation of an organization and industry are high for individuals who will be future Engineers to be able to master these elements in depth.

1.2. Discriminant Analysis

Discriminant Analysis (DA) is systematically used in recent scientific studies [11-13] to identify clusters [14]. Three types of clusters that involved were the heavy, medium and small industry types. DA was also used for the classification of several identified groups [15] and it is a classification technique [16] on observations performed [17] by researchers at the early stage of study [18].

2. METHODOLOGY

This study has been conducted throughout Peninsular Malaysia which is involved in small, medium and heavy industry industrial activities. A set of questionnaires was distributed by researchers to obtain feedback from industry, employers and organizations involved in the process of finding and obtaining workforce in Mechanical Engineering. All questionnaires have been distributed, updated into XL-stat software. All of the data were generated and the results of the study involved Discriminant Analysis (DA).

3. RESULTS AND DISCUSSION

A total of 300 respondents have responded to this Generic Skill question item. Five questions items for Generic Skills (Knowledge)-(GSK), six question items for Generic Skills (Skill)-GSS and six Generic Skills (Attitude) questions items.

3.1. Generic Skills (Knowledge)-(GSK)

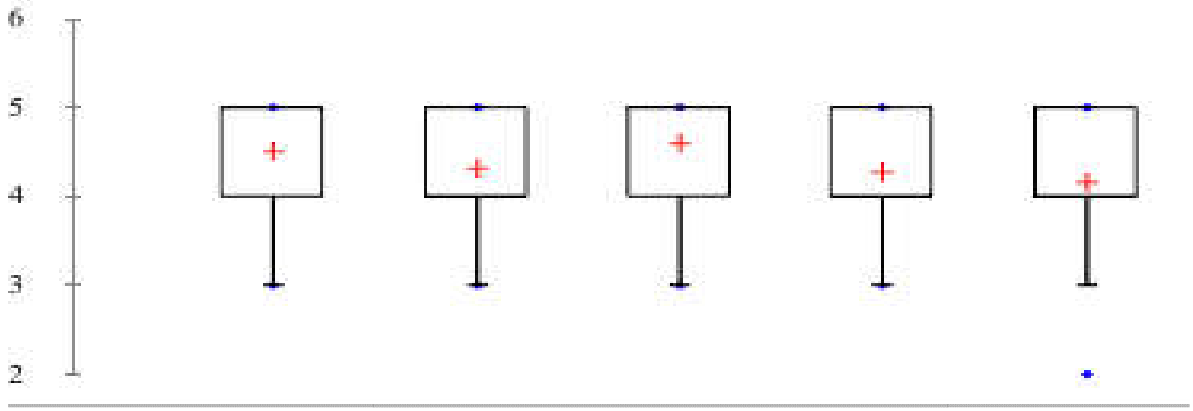

Fig.2. Box plots mean generic skills (knowledge)

Fig. 2 shows Box Plots Mean Generic Skills (Knowledge) that have been obtained through a study conducted by researchers on respondents.

Table 1. Summary of statistics of generic skill (knowledge)

Question Item	Respondent	Minimum	Maximum	Mean Item
GSK1	300	3.00	5.00	4.51
GSK2	300	3.00	5.00	4.32
GSK3	300	3.00	5.00	4.60
GSK4	300	3.00	5.00	4.27
GSK5	300	2.00	5.00	4.16

Table 1 shows the Summary of Statistics Generic Skills (Knowledge) in detail. The findings are seen from the mean reading point for each question item submitted by the respondent. For GSK1 question items, mean readings are 4.51 followed by question items GSK2 with mean values 4.32, GSK3 4.60 and GSK4 4.27. While for GSK5 question items, the mean value recorded is 4.16. This shows the question items for GSK3 precede the mean order followed by GSK1, GSK2, GSK4 and GSK5. The five items of questions show the mean reading at a high level.

Table 2. Descriptive statistics of generic skill question item (knowledge)

Question Item	Frequency	Percentage	Level of Need
GSK1: Descriptive Knowledge: Knowledge represents a product that is designed and its performance	283	94.33	High
GSK2: Normative Knowledge: Illustrates the goals and constraints to achieve and fulfil the designed products.	277	92.33	High
GSK3: Operational Knowledge: The strategies used to choose / generate objects, and how engineers predict their performance and assess their expectations	296	98.67	High

GSK4: Implicit Knowledge: Knowledge is hindered knowing something gradually from time to time based on experience	266	88.67	High
GSK5: Clear Knowledge: Theoretical and academic knowledge is easy to transfer from one side to another.	256	85.33	High

Table 2 shows Descriptive Statistics of Generic Skills Question Items (Knowledge). Question items of KGP3 are ranked first with a percentage of 98.67%, followed by GSK1 94.33%, GSK2 92.33%, GSK4 88.67% and the latest GSK5 85.33%.

Table 3. General summary question item of generic skills (knowledge)

Level of Need	Percentage
High	91.87

The results in Table 3 show the need to produce a competitive Mechanical Engineer at a high level with an overall average of 91.87%. This shows the high level of requirement needed to be mastered by Mechanical Engineers as required by industry and employers today.

3.2. Generic Skills (Skill)-(GSS)

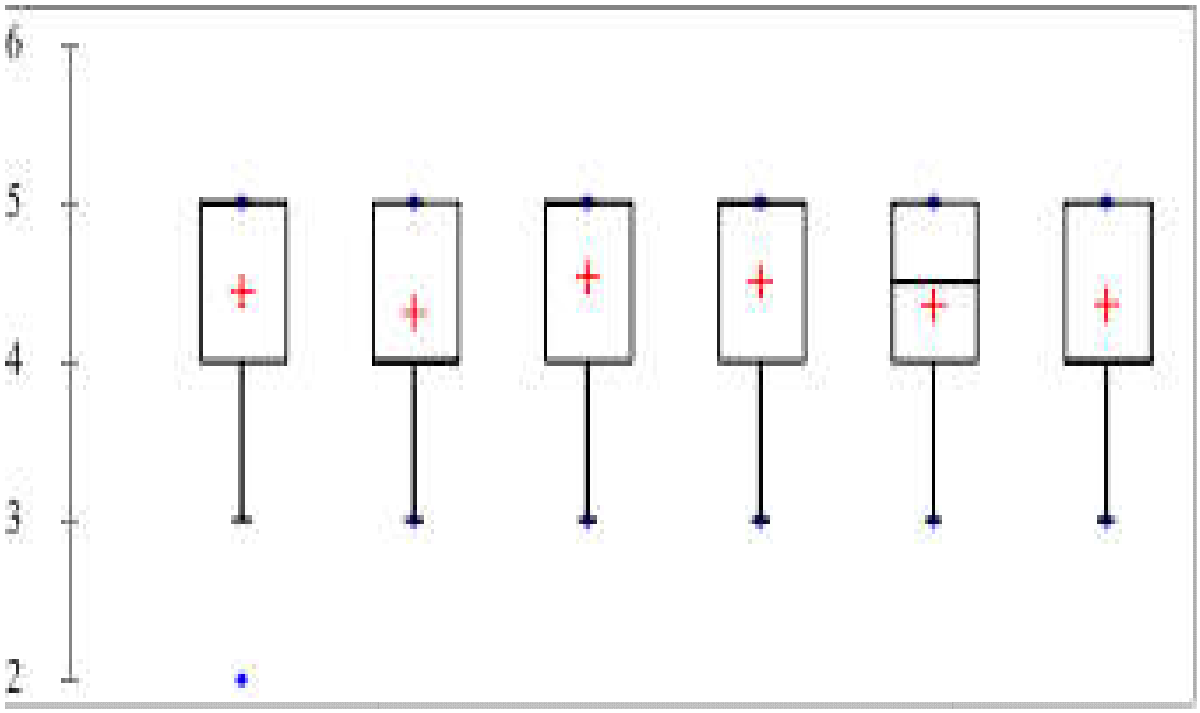

Fig.3. Box plots mean generic skills (skill)

Fig. 3 shows the Box Plots Mean Generic Skills (Skills) that have been successfully obtained.

Table 4. Summary of generic skills statistics (skill)

Question Item	Respondent	Minimum	Maximum	Mean Item
GSS1	300	2.00	5.00	4.44
GSS2	300	3.00	5.00	4.31
GSS3	300	3.00	5.00	4.53
GSS4	300	3.00	5.00	4.50
GSS5	300	3.00	5.00	4.35
GSS6	300	3.00	5.00	4.36

Table 4 shows the Generic Skill Statistics (Skills) summarized in detail. The value of the reading is still based on the mean reading. For GSS1 question items, the mean value recorded is 4.44. Question items GSS2 mean the mean value is 4.31 followed by GSS3 is 4.53, mean reading GSS4 4.50, GSS5 reading value is 4.35 and GSS6 question item is 4.36. This clearly demonstrates, question items in the Generic Skills category (Knowledge) is preceded by GSS3 questions, followed by GSS4, GSS1, GSS6, GSS5 and GSS2 questions items. This study shows that all items in the skill category are still in high demand.

Table 5. Descriptive statistics generic skills question item (skill)

Question Item	Frequency	Percentage	Level of Need
GSS1: Skills in job description	289	96.33	High
GSS2: Skills in concept generation	255	85.00	High
GSS3: Skills in assessment and research	296	98.67	High
GSS4: Skills in detailing product design	287	95.67	High
GSS5: Proficiency in result communication	256	85.33	High
GSS6: Overall skills are presented in the execution process	275	91.67	High

Table 5 shows the Descriptive Statistics of Generic Skill Question Item (Skills). GSS3 question items led the highest reading with a percentage value of 98.67%, followed by GSS1 question items with a percentage of 96.33%, GSS4 95.67%, GSS6 91.67%, GSS5 85.33% and

GSS2 85%.

Table 6. General summary question item generic skill question (skill)

Level of Need	Percentage
High	92.11

Results in Table 6 show the Generic Skills Question Item (Skill) are at a high level of need to produce competitive Mechanical Engineers with a total percentage represented by 92.11%. This indicates that current job requirements still expect the element of this skill to be mastered by the students of Mechanical Engineering as a whole.

3.3. Generic Skills (Attitude)-(GSA)

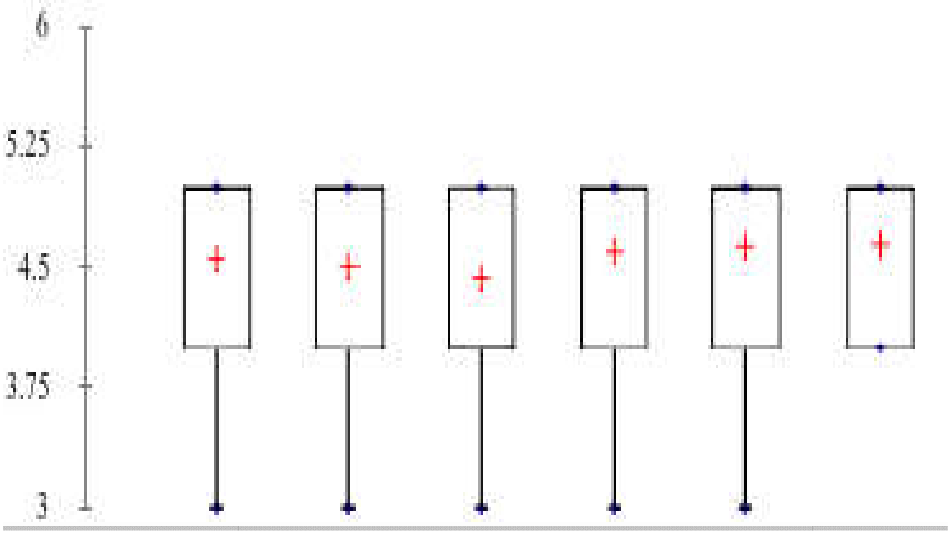

Fig.4. Box plots mean generic skills (attitude)

Fig. 4 shows the Box Plots Mean Generic Skills (Attitude) that have been obtained as the result of the study conducted.

Table 7. Summary of statistics generic skills (attitude)

Question Item	Respondent	Minimum	Maximum	Mean Item
GSA1	300	3.00	5.00	4.55
GSA2	300	3.00	5.00	4.50
GSA3	300	3.00	5.00	4.43
GSA4	300	3.00	5.00	4.59
GSA5	300	3.00	5.00	4.62
GSA6	300	4.00	5.00	4.63

Table 7 is a continuation of the details known as Statistical Formulation (Attitude). The following is the mean reading value obtained through this study. For the GSA1 question, the mean value is 4.55, while GSA2, the mean value obtained is 4.50, followed by GSA3 4.43, GSA4 4.59, GSA5 reading mean 4.62 and last question item GSA6 4.63. This indicates that the highest mean value is preceded by GSA6 question items, followed by GSA5, GSA4, GSA1, GSA2 and GSA3 questions items. This proves that every question item in this study is still at a high level of need.

Table 8. Descriptive statistics item question generic skills (attitude)

Question Item	Frequency	Percentage	Level of Need
GSA1: Behaviour in handling mechanical engineering problems	288	96.00	High
GSA2: Dedication and motivation to become a good Engineer	289	96.33	High
GSA3: Acquisition of knowledge and managing supervised workers	296	98.67	High
GSA4: Teamwork and ability to carry out tasks smoothly	287	95.67	High
GSA5: Time management	281	93.67	High
GSA6: Responsibilities towards the results	300	100.00	High

Table 8 shows Descriptive Statistics of Generic Skills Question Item (Attitude). The GSA6 question item gets the highest percentage requirement of 100.00%, followed by GSA3 98.67%, GSA2 96.33%, GSA1 96.00%, GSA4 95.67% and GSA5 93.67%.

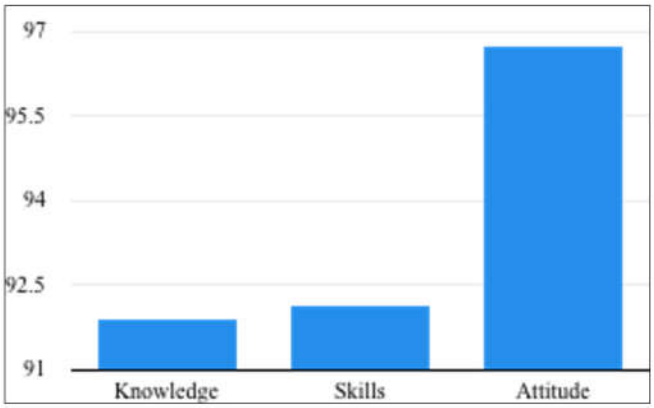

Fig.5. Percentage level of histogram

Fig. 5 shows a comparative histogram percentage of the required level involving three Generic Skills namely Knowledge, Skill and Attitude. The results of the study have shown that these three elements are indispensable to the employers and the industry towards the graduates of Mechanical Engineering. These three elements complement each other to produce the best impact on an engineering organization.

Table 9. General summary item question generic skills (attitude)

Level of Needed	Percentage
High	96.72

Table 9 shows the Overall Summary of Items of Generic Skills Questions (Attitude) to produce competitive Mechanical Engineers at a high level with a total percentage represented by 96.72%. This shows the high level of need to be mastered by Mechanical Engineers to enable individuals to penetrate the job market and meet demand of the employers in the industry.

Table 10. Wilks' Lambda test-heavy industry

Criteria	Value
Lambda	0.263
F (Observed value)	15.699
F (Critical value)	1.451
DF1	34
DF2	562
p-value	< 0.0001
alpha	0.05

Table 11. Wilks' Lambda test-medium industry

Criteria	Value
Lambda	0.265
F (Observed value)	15.469
F (Critical value)	1.451
DF1	34
DF2	558
p-value	< 0.0001
alpha	0.05

Table 12. Wilks' Lambda test-small industry

Criteria	Value
Lambda	0.264
F (Observed value)	15.040
F (Critical value)	1.451
DF1	34
DF2	540
p-value	< 0.0001
alpha	0.05

Table 10, 11 and 12 show the Discriminant Analysis results obtained from the Wilks' Lambda (Rao Budget) test obtained for the Generic Skill-type industry category (heavy, medium, small clusters). Test Interpretation shows H0: The mean vector of the three clusters is the same and 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, the three H0 null hypotheses are rejected and Ha's alternative hypothesis is accepted. The risk of rejecting the H0 zero hypothesis is when the accuracy is lower than 0.01%. The three clusters differ from each other [12].

Table 13. Mistakes matrix for budget samples

From / To	1	2	3	Total	% Correct
1	120	0	0	120	100.00%
2	29	119	0	148	80.41%
3	0	13	19	32	59.38%

Table 13 shows the formulation of the matrix of mistakes for the budget sample involving three types of industry clusters. Based on the table, 120 respondents from the Heavy Industry with the percentage accuracy of 100.00%, 148 respondents from the Medium Industry with the percentage accuracy of 80.41% and 32 respondents from the Small Industry with the percentage accuracy of 57.38%.

4. CONCLUSION

Overall, it can be stated by researcher that industry in Malaysia needs all three elements (Knowledge, Skill and Attitude) in getting a competitive Mechanical Engineer. This evidence can be proven by the results of the study.

Table 14. Generic skill level requirement based on mean

Questions Item	Generic Skills	Percentage	Level
GSK	Attitude	96.72	High
GSS	Skills	92.11	High
GSA	Knowledge	91.87	High

Table 14 shows the order of Generic Skill Requirement Based on Percentage as a result of the research. The Generic Skill includes Attitude with a percentage of 96.72%, followed by Skills 92.11% and Knowledge 91.87%. These three Generic Skills are at a high level of requirement but the most dominant Generic Skills based on the respondents' responses and research is the attitude of a Mechanical Engineer himself. It is indispensable because it can affect the daily work practices. The formation of a professional attitude in the field of Mechanical Engineering is a necessity, as this positive attitude should be practiced throughout the career rather than just a specific place or circumstance.

5. ACKNOWLEDGEMENTS

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