ESTABLISHING THE MALAYSIAN CONTRACTORS' SOFT SKILLS REQUIREMENTS FOR CONSTRUCTION MANAGEMENT GRADUATES: APPLYING THE RASCH MEASUREMENT MODEL

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ABSTRACT

This study aimed to investigate the construction management graduates soft skills required by the Malaysian Construction Industry in performing the entry-level construction managers' role and task. A questionnaire survey method/design using a 5 Likert scale was employed for data collection process. The research instrument adopted 33 items from soft skills development model developed by the Ministry of Higher Education Malaysia to measure industry requirement in seven different dimensions and questionnaire items were analyzed using the Rasch Measurement Model. A total of 72 construction practitioners represent the contractors (grade 5 to 7) in Klang Valley participated in this study. The Rasch measurement model was used to analyze the items and respondents' reliability, the items and respondents' separation index, the items' fit, the levels of items' agreement and the respondents' ability. The findings revealed that the items' reliability index was .75, and the respondents' reliability index was .86. Items' strata index was 2.65, which explains that there are three different levels of items' agreement in this study. Meanwhile, the respondents' strata index was 3.64, which explains that there are three tiers of respondents' requirement in this study. The results also found that 2 items were misfits with the Rasch measurement model based on the values of outfit/Infit MNSQ and the z-standardized index. Rasch Measurement Model identify most of the contractors requires construction management graduates to practice the soft skills in performing entry-level construction managers roles and tasks.

***Keywords**: Soft skill, construction management graduates, Malaysian construction industry, industry requirement and entry level construction manager*

1. INTRODUCTION

In order to perform the management function, construction manager needs to equip themselves with management skills which consist of human skills (generic skills), technical skills and conceptual skills (Amiruddin, Ngadiman & Saidy, 2016). In the past, most of the contractors focused on technical and conceptual skills in hiring their construction manager. However given today's evolving environment, technical and conceptual skills are not sufficient to better prepare a construction personnel in facing the dynamic needs of a challenging global industry. Figure 1 shows the skill distribution at various management levels. This figure can be applied to the construction project life cycle. This is because the construction project life cycle has a different level and scope of management. The working environment and culture of a construction project are unique compared to most working conditions.

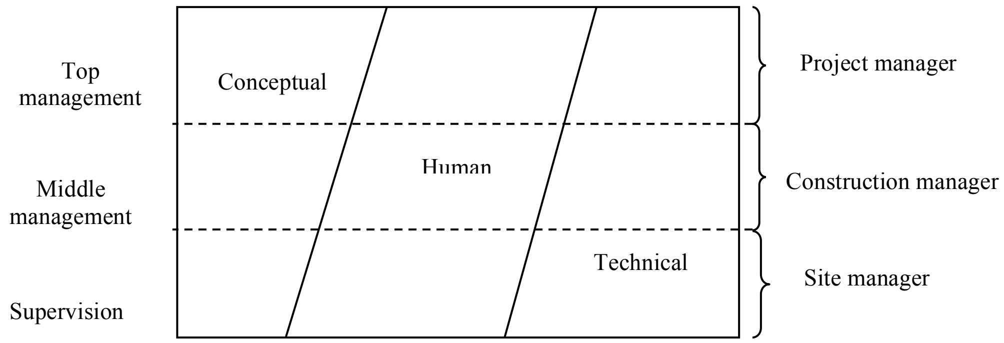

Figure 1: Skills Distribution at Various Management Levels. Adapted from: Katz, 1974; Mat Isa, 2007 in Affandi et. Al (2013)

Construction management skills involve peoples' relationships, which helps to explain why most of the skills relate to direct human and project interrelationship. Relative to social skills, site managers and contract managers stressed on the need for keeping people informed, getting them involved in tasks, fostering cooperation and teamwork, communicating clearly, dealing with people as individuals and showing an interest in people (Smallwood, 2000). Construction management is all about people (soft) skills and technical (hard) skills (Tan, 2005).

Currently, employers seek qualified and talented employees that are quick to learn, who can adapt to change and work on a range of task simultaneously (Harvey, Moon, Geall, & Bower, Graduates' Work: Organisation change and students' attributes., 1997). Moreover, they need employees who are excellent in oral and written communication skills, able to work with other people, able to be flexible and able to adapt the changing of working environment (United States Department of Labour, 2009). As an additional, employees are requested to have the ability to work in teams, able to communicate effectively, able to solve problems and able to manage self (Davies & Poon, 1999). With all the importance of generic skills for entry-level construction managers, therefore, this research was focused on identifying the soft skills required by Malaysian construction industry from construction management graduates.

2. MALAYSIAN SOFT SKILLS DEVELOPMENT MODEL

In 2006, Malaysian Ministry of Higher Education introduced Soft Skills Development Module to address/curb the graduates' unemployed problem. These soft skills are used and embedded into the curricula. Other than that, this module is used for learning outcomes and objectives. However, this soft skills module was developed for various courses in the Malaysian Higher Institution Taken into consideration the unique nature of construction. This module seems to be lacking in producing competence construction managers (Affandi, Hassan, Ismail, Kamal, & Aziz, 2014, Amiruddin et al. 2015**)**. Soft skills are defined as the critical job-related skills that involve little or no interaction with machines and whose applications on the job are quite generalized (Whitmore & Fry, 1974). Soft skills complement technical skills to fulfill a major role in shaping an individual (Bernd, 2008).

Soft skill development model consists of seven soft skills namely communication, critical thinking, and problem-solving, teamwork, lifelong learning, entrepreneurship, ethics and professionalism, and leadership. A total of 33 elements of soft skills used as the program learning outcome (PLO) and course learning outcome (CLO) of the program. This model was used as a guideline in developing program curriculum and drawn up in line to achieve the outcome based education (OBE) by universities. Moreover, the soft skills development model was implemented in every university program PLO and CLO. Therefore, this study adopted this soft skills model for the purpose of determining soft skills required by the Malaysian construction industry.

3. OVERVIEW OF RASCH MEASUREMENT MODEL

This research employed a Rasch measurement model specifically designed for survey rating scale, namely the Rasch Rating Scale Model (Andrich, 1978). This model is appropriate for Likert scale data because it relates the amount of person's latent trait (e.g., one's tendency to agree with a statement) to the probability of an item response on a single scale. It is only when these two elements were placed on the same scale and compared that truly meaningful inferences about person and interactions are made. Rasch analysis utilizes Winsteps measurement software to test data-to-model fit (dimensionality), data measure quality (item fit) and illustrates the construct hierarchy by way of item maps.

3.1 Reliability

Reliability refers to an extent to which a scale produces consistent results if it repeats the measurements which are made of the variables of concern (Malholtra, 2003). Reliability and error are related, and thus the larger the reliability, the smaller the error (Punch , 1998). Therefore, the main objective of reliability is to minimize the errors and biases in research. This research applies Item Response Theory (IRT) analysis through Rasch Model in analyzing the reliability of the research instrument where the values of item and person are identified. Two types of reliability and separation estimations are utilized in Rasch Analysis; "Real" and "Model." "Real" is used to determine the lower bound and "Model" is the term used to identify the upper bound of estimates. The true reliability and separation estimations likely fall between the “Real” and “Model” (Linacre., 2011). Table 1, shows the quality criteria for person and item measurement reliability.

Table 1: Rating Scale Instrument Quality Criteria

Criterion	Poor	Fair	Good	Very Good	Excellent
Person and Item Measurement Reliability	< .67	.67 - .80	.81 - .90	.91 - .94	> .94

Source: Aziz (2010)

3.2 Item measure quality

Infit and outfit mean square fit statistics are also included to examine the content validity (Royal. & Elahi., 2011) of the framework. Rasch item fit monitors the compatibility of the raw item data with the Rasch model expectations and includes two types of fit statistics: (1) the outfit statistics and (2) the infit statistics (Bond & Fox, 2007). Infit statistics are sensitive to unexpected behavior that affects response to the items. On the other hand, outfit statistics are sensitive to unexpected behavior on items. Outfit statistic is more sensitive to respond to items with difficulty far from a person and vice versa (Aziz, 2010).

In general, infit and outfit statistics can be reported as the MnSq as well as the standardized Z values (Zstd) (Bond & Fox, 2007). The infit and outfit MnSq statistic in the range of 0.5 to 1.5 and their Zstd value ranging from -2.0 to 2.0 deemed accepted when considering possible misfit or overfit of items (see Table 2 and 3). The misfitting items value are more than MnSq 2.0 are eliminated from the framework in a stepwise manner by inspecting a series of infit and outfit MnSq value and their Zstd. Items with MnSq 1.5 to 2.0 will be further investigated in qualitative phase before considering their removal from the framework.

Table 2: Interpretation on Mean –Square Value

Mean-square Value	Implication for Measurement
> 2.0	Distorts or degrades the measurement system. Maybe caused by only one or two observations.
1.5 - 2.0	Unproductive for the construction of measurement, but not degrading.
0.5 - 1.5	**Productive for measurement.**
< 0.5	Less productive for measurement, but not degrading. May produce misleadingly high reliability and separation coefficients.

Table 3: Interpretation on Zstd Value

Standardized Value	Implication for Measurement
≥ 3	Data very unexpected if they fit the model (perfectly), so they probably do not. However, with large sample size, substantive misfit may be small.
2.1 - 2.9	Data are noticeably unpredictable.
-2.0 - 2.0	**Data have reasonable predictability.**
≤ -1.9	Data are too predictable. Other "dimensions" may be constraining the response patterns.

Source: Aziz (2010)

3.3 Item hierarchy

The ability to identify items on an interval scale, enhance one's capability to understand a construct and recognize potential inadequacies in a given scale (Green, 1996). The item map illustrates the construct hierarchy for entry-level construction managers' roles and tasks and generic competency. When the principal response to items, they indicate their level of satisfaction using an ordinal rating scale.

Using Rasch Rating Scale Model, these raw ordinal data responses are converted to their natural logarithm, thereby producing interval level measure or logits (Esa & Mustaffa, 2015). Similar to a ruler, which uses inches to represent equidistant interval level units of measure, item maps use logits. The most difficult items for the principal to express agreement with are the items at the top of the map (positive logit). The least difficult item for principals to express agreement with were items at the bottom of the map (negative logit).

4. METHODOLOGY

This study adopted a survey design research in achieving the research aim and objectives. Cluster sampling technique was selected as a sampling method in this research. The target population of the quantitative phase of this study includes the contractor or construction practitioner in Malaysia. In Malaysia, there are seven grades of contractors, which are categorized from 1 to 7. A total of" 2,679 contractors Grade 5 -7 in the Klang Valley registered in Construction Industry Development Board (CIDB) Malaysia are chosen as a sample in this research. Contractors' grades 5 to 7 chosen in this research due to the establishment and most of them employed construction management graduates rather than contractor grade 1 to 4. This sample can represent the whole population because construction industry has the same construction life cycle and technology no matter where the construction held.

The data in this research is analyzed by Rasch model. In many applications one logit change correspondent to one-grade level advance (Lee., 1992). Measure based on item calibration with random deviations up to 0.5 logits are for all practical purposes free from bias. This research is expected to calibrate item with ± 1 logit and 99% confidence level. Therefore, the minimum size which has been selected for this research is 50. The sampling frame and total of questionnaire respond will be discussed further.

Table 4: Sampling Size and Logit for Item Calibration

Item Calibrations stable with	Confidence	Minimum Sample Size Range	Size for Most Purposes
± 1 logit	95%	16 - 36	30
± 1 logit	99%	27 - 61	50
± 1/2 logit	95%	64 - 144	100
± ½ logit	99%	108 - 243	150

Source: Aziz (2010)

In answering this set of the survey, respondents were provided with the entry-level construction managers' roles and tasks framework as a reference. This survey contained:

i. Demographic
ii. Soft skill development model by Ministry of Higher Education (MOHE) (2016) Likert scale that used in the questionnaire is the frequency scale (Vagias, Likert-type scale response anchors. , 2006) which are:
Very unimportant (1), Unimportant (2), Moderately Important (3), Important (4), Very Important (5).

5. RESULT AND DISCUSSION

5.1 Reliability

The summary statistics revealed that the Cronbach- α value was .94 which is acceptable indicating the test reliability in measuring the soft skills required by the Malaysian construction industry towards construction management graduates. Table 5 shows, item reliability, is considerably low at .75 which means that there were, sufficient number of items to measure what it needs to measure. According to Azrilah Aziz (2010), this is a high value of reliability which means there is a great consistency of a set of questions asked in this particular category, behavior. The instruments can reliably separate the person perception apart.

Table 5: Soft skill development model by MOHE (2016)

Soft Skill	Spss Variable Name
Communication Skills	
Deliver ideas clearly and effectively, orally and in writing	CS1
Practice active listening skills and respond	CS2
Make a clear presentation	CS3
Using technology in the presentation	CS4
Negotiate and reach agreement	CS5
Communicate with the participants from different cultures	CS6
Develop personal communication skills	CS7
Able to use non-verbal skills	CS8
Critical thinking and problem-solving skills	
Identify and analyze problems in complex situations	CT1
Expand and improve thinking skills	CT2
Find new ideas and alternative solutions	CT3
Think beyond the limits	CT4
Make decisions based on valid evidence	CT5
Survive and give full attention to the given duties	CT6
Adapt to the new community and environment	CT7
Teamwork skills	
Build good relationships	TS1
Respect others	TS2
Contribute to the planning and coordinating team effort	TS3
Responsible for the team result	TS
Lifelong learning	
Find and manage relevant information from various sources	LL1
Accept new ideas and capable of autonomous learning	LL2
Develop inquisitive mind and knowledge	LL3
Entrepreneurship skills	
Identify business opportunities	ES1

Soft Skill	Spss Variable Name
Plan a business	ES2
Develop, explore and seize business opportunities	ES3
Self-employed	ES4
Ethic and Professionalism	
Understand the impact of economic, environmental and socio-cultural professional practice	EP1
Analyze and make decisions and solving ethic problems	EP2
Practice ethical behavior	EP3
Leadership skills	
Basic knowledge of leadership theory	LS1
Able to lead a project	LS2
Able to switch role between the team leader and team members	LS3
Able to supervise team members	LS4

For an instrument to be useful, separation should exceed 2.0, with higher values of separation representing the greater spread of items and persons along a continuum. If the statistically distinct levels of item difficulty are defined as difficulty strata with centers three calibration errors apart, then this separation index G can be translated into the number of item strata defined by the test H and similarly for persons (Wright & Master, 1982).

Table 6: Item and Person Reliability

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CRONBACH ALPHA (KR-20)RELIABILITY = .95

MEASURED: 72 PERSON
-------------------------------------------------------------------------------
|          TOTAL                             MODEL         INFIT        OUTFIT    |
|          SCORE     COUNT     MEASURE     ERROR      MNSQ   ZSTD   MNSQ   ZSTD |
|-------------------------------------------------------------------------------|
| MEAN     129.2      31.7        2.11      .37                                 |
| S.D.      20.0       1.4        1.57      .44                                 |
| MAX.     160.0      32.0        6.48     1.82                                 |
| MIN.      71.0      22.0        -.81      .18       .11   -7.0    .11   -6.9 |
|-------------------------------------------------------------------------------|
| REAL RMSE    .59 TRUE SD    1.46  SEPARATION  2.48  PERSON RELIABILITY  .86 |
|MODEL RMSE    .58 TRUE SD    1.46  SEPARATION  2.52  PERSON RELIABILITY  .86 |
| S.E. OF PERSON MEAN = .19                                                     |
-------------------------------------------------------------------------------
PERSON RAW SCORE-TO-MEASURE CORRELATION = .78
CRONBACH ALPHA (KR-20) PERSON RAW SCORE "TEST" RELIABILITY = .95

MEASURED : 32 ITEM
-------------------------------------------------------------------------------
|          TOTAL                             MODEL         INFIT        OUTFIT    |
|          SCORE     COUNT     MEASURE     ERROR      MNSQ   ZSTD   MNSQ   ZSTD |
|-------------------------------------------------------------------------------|
| MEAN     290.7      71.2         .00      .15      1.00     .0    .99     .0 |
| S.D.      16.0        .6         .32      .01       .21    1.2    .25    1.3 |
| MAX.     317.0      72.0         .74      .18      1.59    3.4   1.69    3.4 |
| MIN.     250.0      70.0        -.58      .14       .68   -2.1    .63   -2.1 |
|-------------------------------------------------------------------------------|
| REAL RMSE    .16 TRUE SD     .28  SEPARATION  1.74  ITEM   RELIABILITY  .75 |
|MODEL RMSE    .15 TRUE SD     .28  SEPARATION  1.83  ITEM   RELIABILITY  .77 |
| S.E. OF ITEM MEAN = .06                                                       |
-------------------------------------------------------------------------------
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The number of person strata is 3.64 indicates that the contractor and construction practitioner can be separated into four requirement group. The number of item strata is 2.65 which indicates that the requirement level can be separated into three important level. Thus, the sample of 72 construction practitioner can be separated into four levels of requirement and the 32 items in the soft skills development model can be separated into three levels importance.

The person reliability was .86 indicates that this order of item hierarchy will be replicated with a high degree of probability if the items were given to other comparable cohorts (Azrilah, 2011).

5.2 Item measure quality on soft skills requirement

The result from Table 7 shows every item have positive Point Measure Correlation and a small measurement error mean of SE +0.15 logit. The spread of logit scale shows the maximum item measure value is +0.74 logit, and the minimum values are at -0.58 logit. This is giving a total ruler length of 1.32 logit against the person of 7.29 logits. This study refers to the common logit scale since this is the same scale that is used in measuring both the person ability and the item difficulty, therefore, it compares both variables on the same interval scale. The difference between logit max where "Able to use non-verbal skills" (CS8) and the min logit min where "Expand and improve thinking skills"(CT2) located δ = 1.32. This indicates that the item difficulty of the item spread over 1.32 logit unit.

The quality of the item is determined by the attributes point measure correlation. The PMC value must be within the acceptable parameter which is = x, $0.4 < x < 0.8$. Table 7 shows that all items fit inside the range. The further verification is done by looking at the outfit column for Mean Square value; MNSQ = $0.5 < y < 1.5$. From Table 7, one item (CS8) "Able to use non-verbal skills" is out of the range at MNSQ 1.69 logit. Furthermore, having an item with larger MNSQ than the sum of the mean of IMNSQ and SD gives an indication of possible high z-std; in this case 1.21 logit thus item misfit. Table 7 shows item (CS8) "Able to use non-verbal skills" are misfits with MNSQ > 1.21logit and z-std>+/-2.0. Meanwhile, item (TS1) "Build good relationships" only have 0.01logit more than 1.21 logit with z-std still in the range. Therefore, item TS1 is counted as fit due to the z-std>+/-2.0. Further checks were done on the Z-Std value, where Z-Std = z, $-2 < z < +2$; and it was found that the following items, CS5- "Negotiate and reach agreement" and CS7" Develop personal communication skills," both falls outside the set range. However, this two items MNSQ value is in the range of 0.5 < y < 1.5. Therefore, this two items is fit for the model.

Scrutiny of items from the same dimension having the same measure shows items (CT3) "Find new ideas and alternative solutions" and (CT1) "Identify and analyze problems in complex situations" at -0.46 logit. (CS2) "Practice active listening skills and respond" and (CS7) "Develop personal communication skills" at 0.04 logit and (CS5) "Negotiate and reach agreement" and (CS6) "Communicate with the participants from different cultures" at 0.24 logit. This is because respondents see the items as measuring the same thing. An item whose MNSQ is nearer to 1 and z-Std nearer to 0 is deemed a better fit. Thus, items (CT1), (CS2) and (CS6) is maintained, and items (CT3), (CS7) and (CS5) should be deleted or phrased to preserved content validity.

Table 7: Item Measure Quality

ITEM STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM
7	250	70	.74	.14	1.59	3.4	1.69	3.4	.45	.61	30.8	40.0	CS8
15	253	70	.70	.14	1.23	1.5	1.22	1.3	.52	.61	36.9	40.1	TS1
12	269	71	.45	.14	1.04	.3	1.01	.1	.57	.58	39.4	42.7	CT5
14	270	71	.43	.14	1.09	.6	1.12	.7	.55	.57	40.9	42.7	CT7
13	275	71	.32	.14	1.10	.7	1.11	.7	.54	.56	34.8	43.7	CT6
4	279	71	.24	.15	1.38	2.2	1.47	2.3	.47	.55	28.8	45.2	CS5
5	279	71	.24	.15	.84	-1.0	.80	-1.1	.60	.55	39.4	45.2	CS6
19	284	72	.24	.15	.89	-.6	.81	-1.1	.59	.56	56.1	45.2	ES1
22	282	70	.15	.15	.85	-.9	.80	-1.1	.58	.54	57.8	45.5	ES4
32	285	71	.13	.15	1.06	.4	1.10	.5	.52	.55	53.8	46.0	LS4
24	286	71	.11	.15	.71	-1.9	.66	-1.9	.62	.55	56.9	46.1	LL2
30	287	71	.09	.15	1.24	1.4	1.39	1.8	.47	.55	53.8	46.2	LS2
28	288	71	.06	.15	.72	-1.8	.84	-.8	.60	.54	60.0	46.3	EP3
2	293	72	.04	.15	1.18	1.1	1.17	.9	.49	.54	40.9	46.2	CS2
6	288	71	.04	.15	.68	-2.1	.63	-2.1	.62	.53	48.5	46.2	CS7
25	289	71	.04	.15	.72	-1.8	.70	-1.7	.60	.54	58.5	46.3	LL3
31	290	71	.02	.15	.85	-.9	.76	-1.2	.59	.54	61.5	46.4	LS3
23	293	71	-.05	.15	1.07	.5	1.03	.2	.52	.53	56.9	47.2	LL1
20	298	72	-.07	.15	.88	-.7	.83	-.8	.56	.52	62.1	47.1	ES2
3	294	71	-.10	.15	1.07	.4	1.18	.9	.49	.52	54.5	47.5	CS3
18	299	72	-.10	.15	.83	-1.0	.85	-.7	.56	.52	59.1	47.5	TS
17	301	72	-.15	.16	.70	-1.9	.66	-1.8	.58	.52	51.5	47.8	TS3
27	297	71	-.15	.16	.77	-1.3	.72	-1.4	.59	.52	56.9	47.9	EP2
29	297	71	-.15	.16	1.02	.2	.86	-.6	.54	.52	56.9	47.9	LS1
26	298	71	-.17	.16	.98	.0	.94	-.2	.55	.52	56.9	48.9	EP1
1	301	71	-.26	.16	1.15	.9	1.04	.3	.48	.51	49.2	49.1	CS1
21	308	71	-.40	.17	1.12	.7	1.16	.8	.44	.47	38.5	51.4	ES3
8	313	72	-.46	.17	1.03	.2	.86	-.5	.51	.48	57.6	51.7	CT1
10	313	72	-.46	.17	1.07	.4	1.18	.8	.45	.48	51.5	51.7	CT3
16	313	72	-.46	.17	1.03	.2	.85	-.6	.50	.48	63.6	51.7	TS2
11	314	72	-.49	.17	1.14	.7	1.27	1.1	.45	.48	50.0	51.9	CT4
9	317	72	-.58	.18	1.11	.6	1.11	.5	.46	.47	51.5	53.3	CT2
MEAN	290.7	71.2	.00	.15	1.00	.0	.99	.0			50.5	47.0	
S.D.	16.0	.6	.32	.01	.21	1.2	.25	1.3			9.5	3.2	

5.3 Item hierarchy on soft skill requirement

Figure 2 shows the Wright map (person-item distribution map) where the person (contractor or construction practitioner) are plotted on the left side, and the item (soft skills model) are plotted on the right side of logit ruler. This allows both persons' ability and items difficulties to be measured and placed on the same logit ruler. The wright map shows as high item difficulty mean a low level of agreement with the item. It is mean, the item at the top of the scale are harder to agree with while items at the bottom of the scale are easier to agree with. The person at the top of the scale is agreeable with the items in the questionnaire. Meanwhile, the person in the bottom of the scale is less agreeable even with the easiest or common soft skill requirement.

From figure 2, the most person with high requirement on the soft skills is at +6.48logit. The person with the least soft skill required from construction management graduates is at -0.81. The difference between Maxperson and Minperson is 5.67 logit. Item CS8 and CT1 are observed as the most difficult items to be agreed to be important, while item CT1, CT2, Ct3, CT4, and TS2 are the easiest item to agree to be important.

The Wright map in figure 2, tells that G-1 and G-2 are an item free person because of the different psychometry which means homogeneity exist despite the differences in the soft skill requirement. It can be concluded that person who falls under G1 category are the respondents who can easily agree with the requirement and have the same perception of the soft skill required from the construction management graduates. On the other hand, the only person who in the G-2 category is someone who is thinking that soft skills are not essential or not required in performing entry-level construction managers roles and tasks.

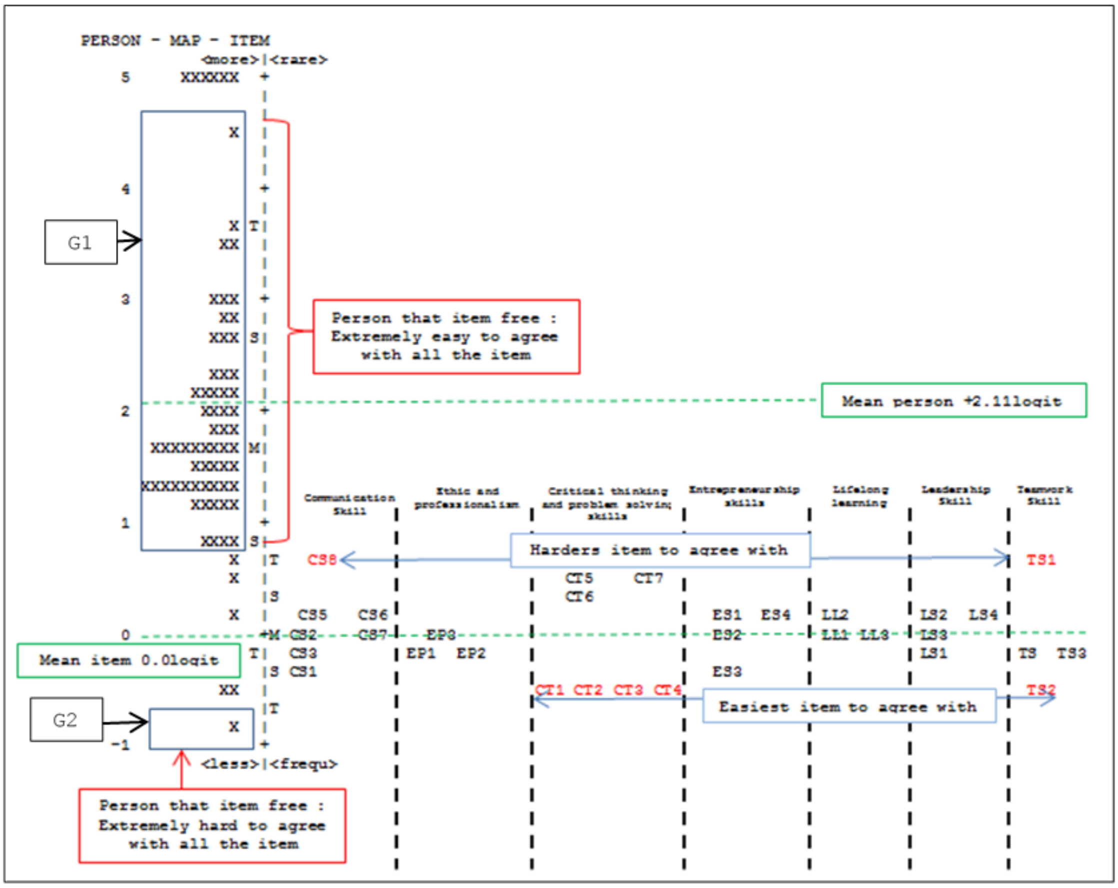

Figure 2: Wright Map

6. CONCLUSION

This study shows that Rasch model provides a very robust platform to measure constructions' practitioner requirement toward construction management graduates. The construction industry accepts soft skill development model by Ministry of Higher Education Malaysia. In this case, the analysis has been helpful in identifying the important soft skills that are required of construction management graduates by the industry. The information can be very useful in ensuring students disciplines build up their soft skills from early on in their studies. The technique used here is equally helpful in ascertaining skills requirements among graduates irrespective of TVET disciplines

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