APPLYING THE RASCH MODEL TO CONSTRUCT THE SHIPPING INDUSTRY EMPLOYABILITY INDICATORS

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ABSTRACT

In recent years, with the increase of the unemployment rate, employability has become a popular issue for different industries, as it can enhance the employment rate for industries and project industrial growth. This study examines shipping-related industries using the Rasch model, to construct scientific evaluation items in relation to the professional techniques and skills of the shipping-related industries. It further validates whether the generalized employability in the shipping-related industries is needed. Research findings are reorganized as employability indicators of the shipping-related industries. The findings are expected to serve as references for the shipping industry to evaluate new employees and for departments within the shipping industry to plan necessary courses. It is suggested that students who intend to enter shipping-related industries should enhance their foreign language proficiency, while the individual department focus on the work attitude, team work in the workplace, and virtue and personal emotion management.

I. INTRODUCTION

1. Research Motives and Purposes

Currently, employability is a popular issue in different industries, with an increase in the unemployment rate, employability becomes important (Lu, 2008; Shi, 2008). Maintaining control of an important source of corporate competitiveness, human resources, will increase benefits for enterprises. According to an investigation by the Youth Development Administration, Executive Yuan, employability (2009) is defined as professional techniques and skills and workplace competency. Professional techniques and skills depend on the requirement of different industries. Core employability refers to general capabilities, which can be applied to different works. However, in different industries, there is no complete regulation on professional techniques and skills.

Export and import-trading industries, which are critical in the economic development in Taiwan, rely on the shipping-related industries. In the past research concerning professional techniques and skills related to the shipping-related industries, researchers have designed a questionnaire from the perspectives of firms and students (Tasi, 2006; Chen, 2007; Han and Chen, 2012). It is uncertain whether the respondents have a consistent rationale toward the questionnaire items. To effectively use appropriate items to measure the subjects' real items based in cognition, through past exploration of professional techniques and skills of shipping-related industries, this study designs a questionnaire. Through the application of the Rasch model, this study establishes the scientific score evaluation method on professional techniques and skills of shipping-related industries. Item Response Theory (IRT) is applied to validate the reliability and validity of the questionnaire items. Finally, the Rasch model is used to find whether the employability is required by current industries. From the perspective of industry, this study probes into the proper professional techniques and skills for shipping-related industries, i.e., the professional techniques and skills that must be possessed by graduates of departments related to shipping, to meet the demand of industry's labor market and increase the employment rate of individuals entering into shipping-related industries. Employability indicators of shipping-related industries are developed. The research purposes are shown below:

1. To use the Rasch model to find the difficulty for firms and graduates on items (reliability and validity of items).
2. To find if there is a significance for graduates of "departments of shipping" on the importance of employability.
3. To construct employability indicators regarding talents required by shipping related industries.

2. Research Scope and Limitation

Export and import trading within Taiwan is operated by

shipping and air transportation. Thus, this study focuses on shipping and air transportation firms, shipping industries, container freight station industries, and shipping agent industries; it probes into the employability required by shipping-related industries recognized by graduates who are new in the workplace and the importance of the same employability after work. This paper aims to find the cognitive differences held between management and general employees concerning employability.

II. PRELIMINARIES

1. Importance of "Human"

In the current Knowledge economy system, human capital has replaced traditional finance and become the most important asset of enterprises (Liang et al., 2007). Huang et al. (2011) suggested that human resource includes two levels: (1) personal level (personal education, knowledge, skills, attitude, and behavior), (2) group level (interpersonal relations and organizational culture). Since it is not easy to measure and manage these two levels, the imitation will be difficult. Human resources become a critical factor for enterprises seeking competitive advantages. Ma (1999) and Overtoom (2000) suggested that the employers view employees that technical and human relations abilities as corporate competitive advantages.

However, according to news reports and magazines, the unemployment rate for young people has continued to increase (Jiang, 2003; Zhang, 2009). Efforts for lowering the unemployment rate should start at an individual, i.e., "human" level. In a depression, supply and demand of personnel, in different industries, changes dramatically. This is often the case among university graduates; nowadays, there is gap between the higher education offer in Taiwan and the capabilities required by industries. Thus, university graduates' capabilities do not match market demand. After selecting the talents, enterprises should mostly train toward the talents in order to enhance corporate performance. They place the employees at the appropriate positions to use the employees' expertise and enhance work efficiency (Huang et al., 2011). Fitzsimmons (2011) suggested the Service Encounter Triad, which refers to direct interactions between customers and service institutions, would be a useful tool. Recruitment and educational training of service personnel were treated as the success keys of enterprises.

2. Definition of Employability

Overtoom (2000) defined employability as the required professional knowledge, professional skills, and attitudes. Skills in only certain fields are not sufficient for enterprise. Both Hillage and Pollard (1989) and Hogan et al. (2013) suggest that the acquisition and maintenance of employment capability is employability, which is based on personal ambition, the willingness to work hard and social skills. According to the Youth Development Administration (2009) and the research of Cheng et al. (2008), employability is divided into professional techniques and skills and workplace competency.

The former means professional techniques for a specific industry or profession; the latter refers to general capabilities to adapt to and be competent at different jobs. Professional capability is defined as the basic techniques and skills gathered from systematic education and training, and then combined with other necessary cognitions and abilities. Regarding professional personnel's professional service (knowledge, attitude, value, and skills), professional personnel's skills and work ethics are regulated by professional standards to maintain the quality level needed to effectively accomplish the works.

3. Employability of Shipping Related Industries

The evaluation dimensions for professional techniques and skills in shipping-related industries are broad and various. However, foreign language proficiency and shipping-related knowledge and capabilities are mentioned in all forms of literature (Tasi, 2006; Chen, 2007; Han and Chen, 2012; Anonymous, 2013). It demonstrates the importance of language and professional, shipping-related knowledge. However, warehouses, logistics, accounting, knowledge of related regulations, time management, and EQ emotion management, were different evaluation items according to different studies. Thus, this study endeavors to examine useful employability indicators in shipping-related industries through the application of the Rasch model.

4. Rasch Model

Rasch analysis measures each subject's reaction toward the items. According to the subjects' different capabilities and the difficulty of the items, they will have different reactions. The Rasch model has two important characteristics: equidistant and specific objectivity. Difficulty of the items and the subjects' capabilities are independent and will not influence each other. They can validate reliability, validity of the items, and measure consistency of the same capability or characteristics (Wang et al., 2011; Tennant et al., 2004). Thus, by the Rasch model: (1) questionnaire design can match the expectation of any new research (There are different occasions when Rasch analysis would be appliedIt would be applied in the development of a new scale, where it is possible to design the item set to fit the model expectations from the outset); (2) to review the problem of current ordinal scales and delete the inappropriate items (Rasch analysis would be used in reviewing the psychometric properties of existing ordinal scales. Also, the unidimensionality of some existing scales has been called into question, resulting in the necessity of item deletion) (Tennant and Conaghan, 2007).

5. Application of Rasch Model

In 1960, Georg Rasch promoted the Rasch model as an education and psychological measurement, an alternative to already existing ordinal scales (Chang and Wu, 2008). In recent decade, besides being used as an education and psychological measurement, the Rasch model is frequently ap-

plied to medical management (Chao et al., 2007; Chien et al., 2007; Tennant and Conaghan, 2007; Chien et al., 2009; Chang et al., 2010). The Rasch model was applied to measure the living quality, which was modified by equidistant characteristics, and objectivity (Tennant et al., 2004). The Western Ontario and McMaster Universities analyzed long-term living quality and treatment of 2205 patients with coxitis and gonitis by the Rasch model (Wolfe and Kong, 1999). Chang and Wu (2008) adopted it to analysis the quality of papers in order to more objectively test the quality. The Rasch model was also applied to validity analysis and scale modification in order to result in goodness of fit (Covic et al., 2007; Wang et al., 2011). In Taiwan and foreign countries, the Rasch model has been applied to sport, medicine, and test examinations for the subjects' capabilities, reliability and validity of judgment, difficulty of tests, etc. (Yau, 2002; Yau, 2004a; Yau, 2004b; Chao et al., 2007; Chien et al., 2007; Chien et al., 2009; Chang et al., 2010; Lin, 2010; Lin et al., 2011; Yang et al., 2011; Khairani, 2012; Razak et al., 2012). Based on above, the Rasch model is commonly used to test the objectivity of scales, reliability and validity, and the subjects' capabilities. The research scope of this study has never been explored through the use of the Rasch model. This study attempts to develop an employability scale required by shipping-related industries through the characteristics of the Rasch model.

III. RESEARCH METHOD

1. Research Framework

Based on the literature review, this study integrates the researchers' 20 items as Part 1 of the questionnaire: cognitive difference on professional techniques and skills before and after entering the workplace. In Part 2, this study attempts to identify the courses that can enhance students' employability according to suggestions by industrial personnel and graduates working in shipping-related industries; this information will then serve as a reference for students of shipping-related departments to select professional courses in future and prepare for future jobs in shipping-related industries. This study then applies equidistant, specific, and objective characteristics of Rasch model in questionnaire design to find employability cognition required of industry supervisors and graduates before entering workplace and recognition of importance of employability after working to find if supervisors and graduates have different cognition in questionnaire survey and reliability and validity of the questionnaire. Finally, employability indicators required by shipping-related industries in Taiwan are generalized.

According to research motive, research purposes and literature review, this study analyzed and integrated related variables as 20 employability indicators. By Rasch model, the researcher explored the subjects' cognitive abilities, difficulty of items and their correlation and through characteristics of Rasch model, inappropriate items were screened to result in employability indicators of shipping related industries.
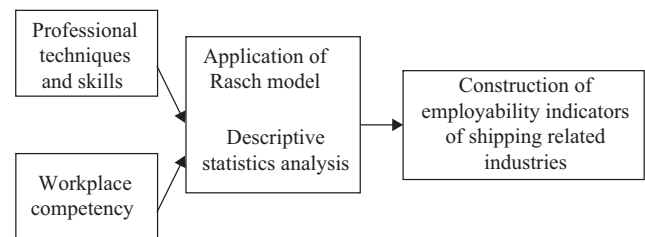

Fig. 1. Research framework.

2. Introduction of Questionnaire Samples

There were 175 samples of questionnaires. An online sample and a paper sample of the questionnaire were created and distributed. The online questionnaire was forwarded by shipping and air transportation associations to members and 113 questionnaires were returned. Additionally, online questionnaires were placed on the "Marinefans" forum and 7 questionnaires were returned. The paper questionnaires were distributed to enterprises that were recruiting employees through the 104 Job Bank and 1111 Job Bank, 55 questionnaires were returned.

3. Item Response Theory

Item Response Theory (IRT) explains the scores after testing from the perspective of individual items. The theory is based on two basic concepts: (1) respondents' performances in relation to a certain item can be predicted by one factor or a group of factors (potential capability or capability). The factors are called "potential characteristics" or "capabilities"; (2) correlation between the respondents' performances with the potential characteristics (capabilities) of the group can be shown and interpreted by one increasing mathematics function (item characteristic curve, ICC). It suggests that the relationship between the certain potential characteristics and potential of the probability of correct reaction to certain items. When the potential characteristics are more significant, the probability of correct reaction to a certain item is higher. In the opposite situation, the probability of correct reaction is lower. The curve includes one or several parameters to describe the characteristics of the items and the respondents' potential characteristics. They suggest the possible relation between students' capability and their correct reaction of the item. For instance, when students' certain professional ability is more significant, the probability to have correct reaction is higher. However, when students' professional ability is less prominent, probability to have a correct response of the item is lower (Yu, 2011).

4. Correlation between IRT and Rasch Model

IRT assumes that person's ability of the subjects is a fixed latent characteristic θ. Thus, a person's ability of the subject n is θ_n. Besides, each item in the test has item difficulty, which is objective and has a fixed level (b, difficulty of item i can be set as b_i). The subjects' performance in the test has fixed

higher limit *d*, which suggests the limit of the score by the subjects' capability. It can be interpreted as a percentage of the higher score after deleting any careless errors in the total score of questionnaire. The subjects' overall performance has fixed lower *c* limit which suggests the subjects' minimum scores and it can be treated as percentage of the lowest score of the subjects by guessing the total score of the questionnaire. In the model, a_i is treated in discrimination of item *i* to show a cumulative probability gap in response to different items.

The Rasch theory is based on the log odds ratio. Rasch suggested that each subject's response to each item is based on the difference of personal capabilities and difficulty of the items. In other words, if most of the subjects have wrong answers in relation to the item, it means that the item is scales higher in difficulty. If one person has more correct answers in more items on the questionnaire, it means the person has one prominent professional capability. Based on the log odds ratio, item difficulty is estimated according to all subjects' performances on certain items. By certain person's performances of all items of a certain profession, personal ability can be estimated. In addition, Rasch analysis can transform the ordinal scores of the original item into a logit equidistant score, which is called specific objectivity. It can find if the item matches a single dimension.

IV. DATA ANALYSUS AND RESULTS

According to the Rasch model, management and employees' capabilities can be recognized, in each item, there is one indicator. When the value is higher, it means the capability is more significant, but when the value is lower, the capability is less significant. With the Rasch model, the researcher analyzes employability requirements recognized by subjects when entering the workplace and the importance of employability after working in the field. As to test of items, 0 is the division of measure. When the measure is higher, the employability is less important. On the contrary, when measure is lower, employability is more important. When Outfit Z Standardized t statistics (Outfit ZSTD) (standardized Z, indicator of reaction fit) is ± 2, it means validity is inferior and it does not meet the Rasch model. As to reliability, Item Reliability (Item REL.) close to 0 is more significant.

1. Rasch model Analysis
Cognition of Employability Requirement When Entering Workplace

According to the first analytical result, Outfit ZSTD of items *6. application of computer software and related certificates*, *1. General business English proficiency (TOEIC above 550)*, *13. Expression and Communication capabilities*, and *18. Strong learning intention and high degree of potential* are not ±2. The validity is inferior and it does not match the assumption of the Rasch model. Thus, these 4 items are deleted prior to completing another Rasch analysis.

According to the second Rasch analysis, the test reliability is 0.96 which is close to 1. Thus, the test reliability of the importance of employability is good. The mean of infit mean square (Infit MNSQ) (one simple indicator of difference between observation value and expectation value) is 1.00 and standard deviation is 0.10. The mean of Infit ZSTD is 0.0 and standard deviation is 0.9. The mean of Outfit MNSQ is 1.01 and standard deviation is 0.11. The mean of Outfit ZSTD is 0.0 and standard deviation is 1.0. Thus, it matches the Rasch model.

The subjects suggest that items: *15. Leadership* (Measure = 1.23), *16. Innovative capability* (Measure = 1.20), *5. Accounting ability* (Measure = 0.71) are less important items of employability. However, items: *11. Active working attitude and positive group interaction* (Measure = -1.37), *14. Discovering and solving problems encountered at work* (Measure = -0.78), *7. Knowledge of international trading documents* (Measure = -0.56), *9. Correct document processing ability* (Measure = -0.54) were found to be more important based to the subjects' responses.

2. Importance of Employability after Working

According to the analytical result, Outfit ZSTD of Items: *5. Accounting ability*, *4. Bill manufacturing ability*, *6. Application of computer software and related certificates*, *19. Recognition and planning of career development*, *1. General business English proficiency (TOEIC above 550)*, *13. Expression and communication capabilities*, *17. International perspective*, *18. Strong learning intention and high degree of potential*, and *14. Discovering and solving problems encountered at work* are not ±2 and the validity is inferior. It does not match the assumption of the Rasch model. These nine items were deleted for the next Rasch analysis.

According to further analysis, the item reliability is 0.91. Thus, the item reliability of the importance of employability is neutral. The mean of Infit MNSQ is 1.00 and the standard deviation is 0.09. The mean of Infit ZSTD is 0 and the standard deviation is 0.9. The mean of Outfit MNSQ is 1.00 and the standard deviation is 0.14. The mean of OutfitZSTD is 0.1 and the standard deviation is 1.1. Thus, it matches the Rasch model.

The subjects suggest that *15. Leadership* (Measure = 0.78), *3. Language expression (Taiwanese, Mandarin, English, and/or other languages)* (Measure = 0.50), *8. Business procedure of overseas import and export* (Measure = 0.29), and *7. International perspective* (Measure = 0.25) are less important employability. However, *9. Correct document processing ability* (Measure = −0.87), *12. Good morality and virtue and EQ emotion management* (Measure = −0.54), and *2. English proficiency of shipping terms* (Measure = −0.42) are important for the subjects.

Table 1 shows the difference of the cognition of employability requirements when entering the shipping industry and the importance after working has begun. (1) *1. General business English proficiency (TOEIC above 550)*, *6. Application of computer software and related certificates*, *13. Expression and communication capabilities*, and *18. Strong learning intention*

Table 1. Order of cognition of employability requirement when entering workplace and importance after working.

Item	Cognition of employability requirement when entering workplace	Employability importance after working
1. General business English proficiency (TOEIC above 550)	Deleted	Deleted
2. English proficiency of shipping terms	6	3
3. Language expression (Taiwanese, Mandarin, English and/or other languages)	13	10
4. Bill manufacturing ability	11	Deleted
5. Accounting ability	14	Deleted
6. Application of computer software and related certificates	Deleted	Deleted
7. Knowledge of international trading documents	3	8
8. Business procedure of overseas import and export	12	9
9. Correct document processing ability	4	1
10. Commercial (international) manners and literacy	8	7
11. Active working attitude and positive group interaction	1	4
12. Good morality and virtue and EQ emotion management	5	2
13. Expression and communication capabilities	Deleted	Deleted
14. Discovering and solving problems encountered at work	2	Deleted
15. Leadership	16	11
16. Innovative capability	15	6
17. International perspective	7	Deleted
18. Strong learning intention and high degree of potential	Deleted	Deleted
19. Recognition and planning of career development	9	Deleted
20. Learning of job-related industrial environment and development	10	5

and high degree of potential are deleted when entering the workplace. This study infers that it does not mean they are not important. In fact, all subjects recognize their importance and they cannot be indicators to select employees since they are basic factors of employability for employees. (2) *4. Bill manufacturing ability, 5. Accounting ability, 14. Discovering and solving problems encountered at work, 17. International perspective*, and *19. Recognition and planning of career development* are deleted since they are considered unimportant for the subjects after entering the workplace. This study infers the following: bill manufacturing and accounting are not essential capabilities for all employees. Thus, if they are treated as indicators to select employees, the scope of indicators will be too narrow; as for discovering and solving problems encountered at work, international perspective and recognition, and planning of career development, this study infers that more than half of the samples have work experience that amounts to less than five years or are general employees, so the subjects are still trying to fit into the workplace or they are not management. Thus, discovering and solving problems, international perspective to deal with works or recognition and planning of career development are not necessary.

According to Table 1, employability indicators of the shipping industry are constructed. Order of importance is as follows: *9. Correct document processing ability, 12. Good morality and virtue and EQ emotion management, 2. English proficiency of shipping terms, 11. Active working attitude and positive group interaction, 20. Learning of job-related industrial environment and development, 16. Innovative capability, 10. Commercial (international) manners and literacy, 7. Knowledge of interna-*

tional trading documents, 8. Business procedure of overseas import and export, 3. Language expression (Taiwanese, Mandarin, English, and/or other languages), and *15. Leadership*.

3. One-Way ANOVA

According to the Rasch model, we must examine the management and employees' capabilities. This study explores the correlation between the capabilities and the subjects' basic information.

1. Cognition of requirement and importance are not significantly different because of the subjects' titles, working years, and departments of graduation.
2. According to research findings of multiple choices questions from Table 2, the subjects suggest that currently, the employability factor which should be improved is *11. Active working attitude and positive group interaction*. This study infers that the subjects realize that teamwork is required in a workplace to accomplish organizational goals. Thus, positive attitudes and group interaction are the most important items for employability, followed by *1. General business English proficiency (TOEIC above 550)*. Using operators and document personnel of Yang Ming Shipping as examples, their score of TOEIC should be at least 550. Flight attendants of EVA Air should have TOEIC scores of at least 550. Supervisors should obtain TOEIC scores of at least 600. Thus, this study suggests that TOEIC scores of 550 is an employability trait that is required in practice. Then there is *12. Good morality and virtue and EQ emotion management*. This study infers that in a harmonious workplace, employees will not be tired, they encourage each other

Table 2. Order of employability which should be enhanced of titles, working years and departments of graduation.

Capabilities which should be improved	Title	Working years	Department of graduation
1. General business English proficiency (TOEIC above 550)	**2**	**2**	**2**
2. English proficiency of shipping terms	5	6	5
3. Language expression (Taiwanese, Mandarin, English and/or other languages)	**3**	4	**3**
4. Bill manufacturing ability	10	11	10
5. Accounting ability	11	12	11
6. Application of computer software and related certificates	9	10	9
7. Knowledge of international trading documents	4	5	4
8. Business procedure of overseas import and export	6	7	6
9. Correct document processing ability	7	8	7
10. Commercial (international) manners and literacy	8	9	8
11. Active working attitude and positive group interaction	**1**	**1**	**1**
12. Good morality and virtue and EQ emotion management	**2**	**3**	**2**
13. Others	12	13	12

when frustration appears, and develop positive forces within organizations that result in positive work circles. Finally, as to *3. Language expression (Taiwanese, Mandarin, English, and/or other languages)*, this study suggests that regarding different titles, work experience, or departments of graduation, the employability is essential since there must be communication in the workplace and the workplace system includes customers, peers, and supervisors.

Cross-analysis is conducted on the employability traits, which should be improved, and the respondents' basic information. According to the study, most of the respondents suggest that *1. General business English proficiency (TOEIC above 550), 3. Language expression (Taiwanese, Mandarin, English, and/or other languages), 11. Active working attitude and positive group interaction*, and *12. Good morality and virtue and EQ emotion management* are important and students' employability should be improved. Based on one result, the respondents have significantly difference from those of the respondents. As to employability which should be improved, the respondents who graduated from departments of applied foreign language selected different items from those who graduated from other departments and selected *7. Knowledge of international trading documents*. This study infers that subjects from departments of applied foreign language have more experience with languages instead of courses related to international trading. Thus, the respondents suggest that they should enhance the item in order to enter the industry.

V. CONCLUSIONS

According to this empirical study, there are 11 employability indicators within the shipping industry: *9. Correct document processing ability, 12. Good morality and virtue and EQ emotion management, 2. English proficiency of shipping terms, 11. Active working attitude and positive group interaction, 20. Learning of job-related industrial environment and development, 16. Innovative capability, 10. Commercial (international)*

manners and literacy, 7. Knowledge of international trading documents, 8. Business procedure of overseas import and export, 3. Language expression (Taiwanese, Mandarin, English, and/or other languages), 15. Leadership. Employability requirements recognized by shipping-related firms and graduates of shipping-related industries and importance of employability after working will not be significantly different because of the subjects' titles, working years and departments of graduation. Thus, the subjects all suggest that students should improve employability as follows: *11. Active working attitude and positive group interaction, 1. General business English proficiency (TOEIC above 550), 12. Good morality and virtue and EQ emotion management and 3. language expression (Taiwanese, mandarin, English or other languages).*

Based on these conclusions, students should be encouraged to strengthen their proficiency with foreign languages. This study suggests that TOEIC scores of 550 is an employability trait that is required in practice. When planning club activities, shipping-related departments should cultivate students' working attitude, team work, virtue and emotion management which are not easy to be absorbed from courses in schools and rely on self-recognition and self-improvement. Therefore, it is suggested that schools/firms hold lectures of related issues to allow students/employees to recognize the importance of the employability and apply it in workplace.

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