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MANPOWER REQUIREMENT OF MANUFACTURING INDUSTRIES: INPUT TO CURRICULUM DEVELOPMENT

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ABSTRACT

This study seeks to know the priority competency skills of manufacturing industries for an entry-level engineering job. Priority matrix index were used in gathering information from the target respondents. There were thirty-two respondents in the study, twelve Human Resource Managers and twenty Industrial Engineering Managers/Practitioners from the thirty-two manufacturing firms in the National Capital Region, Philippines. The resulted top six priority competency skills of the manufacturing industries are: 1.Leadership Skills, 2. Ability to see Big-pictures, 3. Problem Solving Skills, 4. Organization Understanding, 5.Coping Skills and 6. Technological Awareness and Understanding. Correlation analysis among the different competency skills was also conducted using statistics software called SPSS version 14. The correlation analysis reflected that problem solving skills and leadership skills as independent variables and the dependent variables are performance understanding, ability to see the big picture, systems thinking and understanding, and technological awareness. The identified priority skills were validated by the human resource manager of a top multinational company. Then, a self- assessment of the Industrial Engineering curriculum program in relation to the resulted industry priority skills was conducted which resulted to a skill gap analysis. Suggested actions were then identified in order to close the gap. Finally, the implication of this research will serve as benchmark in assessing other engineering curriculum of University X in order to increase the employability of the graduates.

KEYWORDS
Competency Skills, Correlation Analysis, Manpower Requirements

INTRODUCTION

A recent survey showed that there is a mismatch on the skills demanded by the industries to the available supply skills. The results of the survey revealed that "31 percent of employers worldwide are having difficulty filling positions due to the lack of suitable talent available in their markets, which is an increase of one percentage point over last year's survey "(Bizshifts, 2010). Moreover, engineers ranked number 4 on the top 10 jobs that employers are having difficulty filling across the 36 countries and territories. Existing literature conducted several studies about competency skills of engineering graduates. Benshah et al (2011) paper developed functional competency for chemical engineering graduates in close collaboration with personnel in industry. Moreover, the paper describes a methodology in constructing a competency based training modules for undergraduate chemical engineering course. Because it's current engineering education are seen to be deficient in meeting the expectations of the industry to the graduates. Likewise, Warin et al (2011) proposed a methodological framework that enables the course modules to evolve in order to integrate high levels of cognitive skills and professional competencies. The motivation of the framework is based on the goal of aligning the student learning into the workplace realities. The framework is based on seven basic principles that are inclined in an outcome based approach instruction. The proposed framework was applied in three modules, one in the undergraduate course and two in the graduate course. The study found out that the proposed framework is useful in improving teaching scenarios which lead to improving course modules. On the other hand, Goel (2006) in his study collates recommendations about competency skills of engineering graduates from National Academy Engineers (NAE) , Engineering Professor's Council (EPC) ,several authors in the literature and other accreditation agencies. The study noted that the mentioned agencies identified a large number of competencies such as systems level perspective, analytical skills, critical and creative thinking as essential. In the end, the study concluded by proposing a three dimensional taxonomy of competencies such as dimension#1- attitudes and perceptions; dimension#2- Productive habits of mind; dimension#3-meaningful usage , extension and acquisition of knowledge.

Given this phenomena, there is a need to evaluate the required competency skills of employers in order that the supplier which are the Higher Education Institute (HEI) be able to match and address this needs. It is therefore the aim of the study to identify and assess the demand of the manufacturing industries in terms of the required job skills for an entry level engineer. The result and information gathered will aid Higher Education Institute (HEIs) to further evaluate and develop their curriculum in meeting the industries' manpower requirements. Furthermore, this study will help the students in evaluating their existing capabilities and identify their areas of improvement to make them more competitive and have full competence in their field of study.

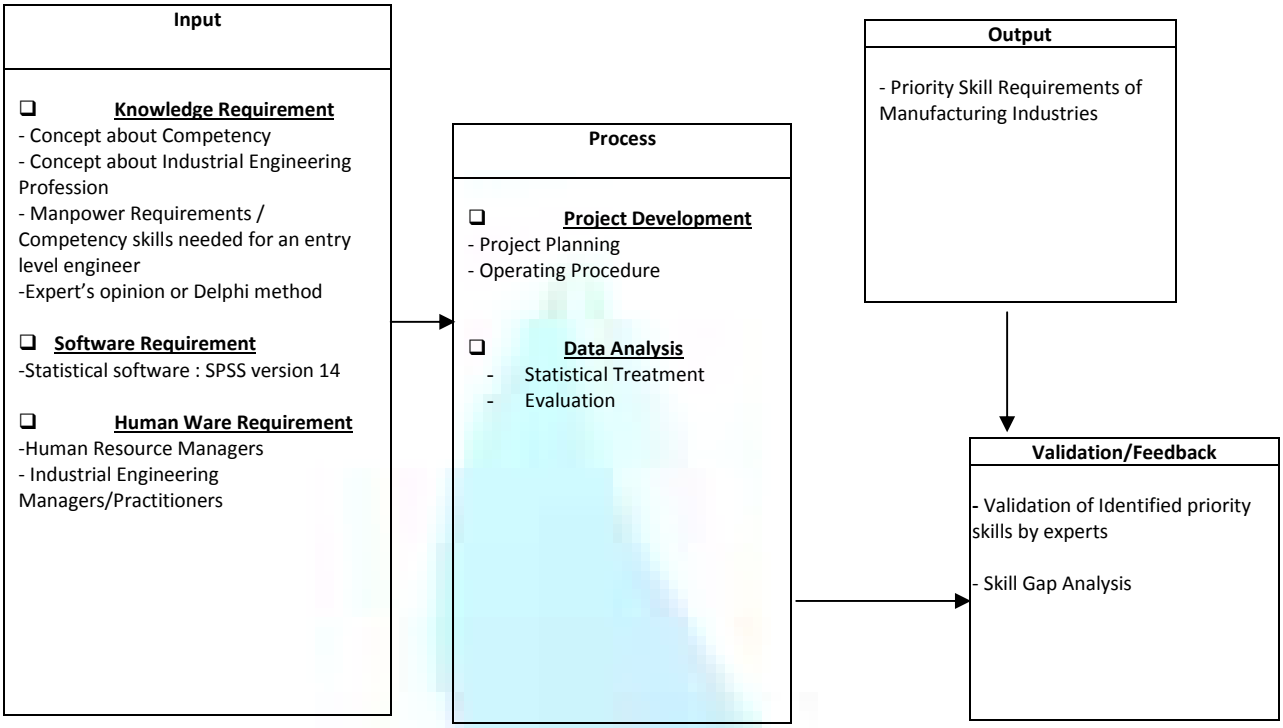
OBJECTIVES OF THE STUDY

1. Determine the competency skills needed for an entry-level engineer in manufacturing industries.
2. Identify the priority competency skills needed for an entry-level engineer in manufacturing industries.
3. Evaluate the interrelationship of these skills.
4. Evaluate existing Industrial Engineering program curriculum offered by University X.

SCOPE AND DELIMITATION

The study will focus on the required competency skills of an entry-level engineer.

FIGURE 1 - CONCEPTUAL FRAMEWORK



Source: results of author's concepts and analysis in the literature and empirical studies

The above figure shows the conceptual framework of the study. Understanding the concepts of competency, industrial engineering profession, industries' manpower requirements and the knowledge of the use of delphi method are essentials in achieving the required output of the study. Statistical software named as SPSS version14 will be needed for treatment of the collected data and to evaluate significant relationship of the different competency skills.

The survey returns from the target respondents particularly the Human Resource Managers and the Industrial Engineering Managers/Practitioners is also an input to the study.

After input, project development follows; the planning of the project began when the short listed competency skills were chosen from the standard established by the American Society of Training and Development for Human Performance Improvement: Roles, Competencies and Outputs by Rothwell (1999). Then, operating procedures follows, where survey questionnaires were randomly distributed to the different manufacturing firms. The data gathered from the survey questionnaires were tallied with the use of SPSS version14. The final output is the priority skills requirements of manufacturing industries. The human resource manager and industrial engineering manager from top multinational company validated the resulted priority competency skills. Lastly, skill gap analysis was conducted through the evaluation of the industrial engineering program curriculum as against the identified priority skills requirements.

METHODOLOGY

This study used qualitative and quantitative method in achieving the objective of the study. In qualitative method, delphi method or expert's opinion were used through survey questionnaire. Mean of the total score for each competency skills were calculated from the responses of the respondents and Pearson r coefficient was used to determine the significant relationship of the different variables in the study.

The respondents are either the Human Resource Manager or Industrial Engineering Manager/Practitioner. The 15 competency skills in the survey questionnaire were taken from 'ASTD Models for Human Performance Imporvement: Roles, Competencies, and Outputs" by William J. Rothwell (1999) because it covers all the skills needed for an entry-level candidate as validated in several related studies. The identified competency skills are as follows: Industry Awareness, Leadership Skills, Interpersonal Relationship Skills, Technological Awareness and Understanding, Problem-Solving Skills, Systems Thinking and Understanding, Performance Understanding, Knowledge of Interventions, Organization Understanding, Negotiating/Contracting Skills, Buy-in/Advocacy Skills, Coping Skills, Ability to See "Big Picture, Consulting Skills. These competency skills will be used as the content of the survey questionnaire of the study.

PROCEDURE

The respondents were instructed to apply pairwise comparison in identifying their preferred competency skills. The instruction in entering the data in the questionnaire is shown below:

Competency Skills	Leadership Skills	Problem Solving Skills	Business Understanding	Technological Understanding	Total Score
Leadership Skills	**X**	**0**	**0**	**0**	**0**
Problem Solving Skills	**1**	**X**	**1**	**1**	**3**
Business Understanding	**1**	**0**	**X**	**1**	**2**
Technological Understanding	**1**	**0**	**0**	**X**	**1**

Compare each of the skills and write 1 in the row of the chosen skill. And write 0 in the assigned row of the un-prefer skills. For example in the above table the respondent preferred problem solving skills more than leadership skills in hiring entry level engineers, hence the value of 1 was reflected in the second row of the first column. This cell (C21) is the intersection of problem solving skills and leadership skills. Then, write the value of 0 to the first row second column (C12) of the table. The computation of score is horizontal. The respondent will continue in the next cell until he fills up all the cells in the table. The resulted score of the example reflected that problem solving skills is the respondent's top most priority since this got the highest score, followed by business understanding, then technological understanding and last is leadership skills.

STATISCTICAL TREATMENT OF DATA

Descriptive Statistics was used such as the measurement of central tendency of each competency skills. Correlation analyses among the competency skills were also computed using Pearson r.

RESULTS

The primary purpose of this study was to determine, in rank of order of importance, the competency skills/employability skills that employers in manufacturing industry seek in entry-level engineering jobs. The respondents of the study are the twelve (12) Human Resource Officers and twenty Industrial Engineering Managers/Practitioners from the thirty two different manufacturing industries. The total average workforce of the responded manufacturing firm has 688 workers.

RANKING OF COMPETENCY SKILLS

The survey questionnaire returns from the different manufacturing companies within the National Capital Region (NCR) resulted in the following ranking.

TABLE 2 - RANKING OF COMPETENCY SKILLS

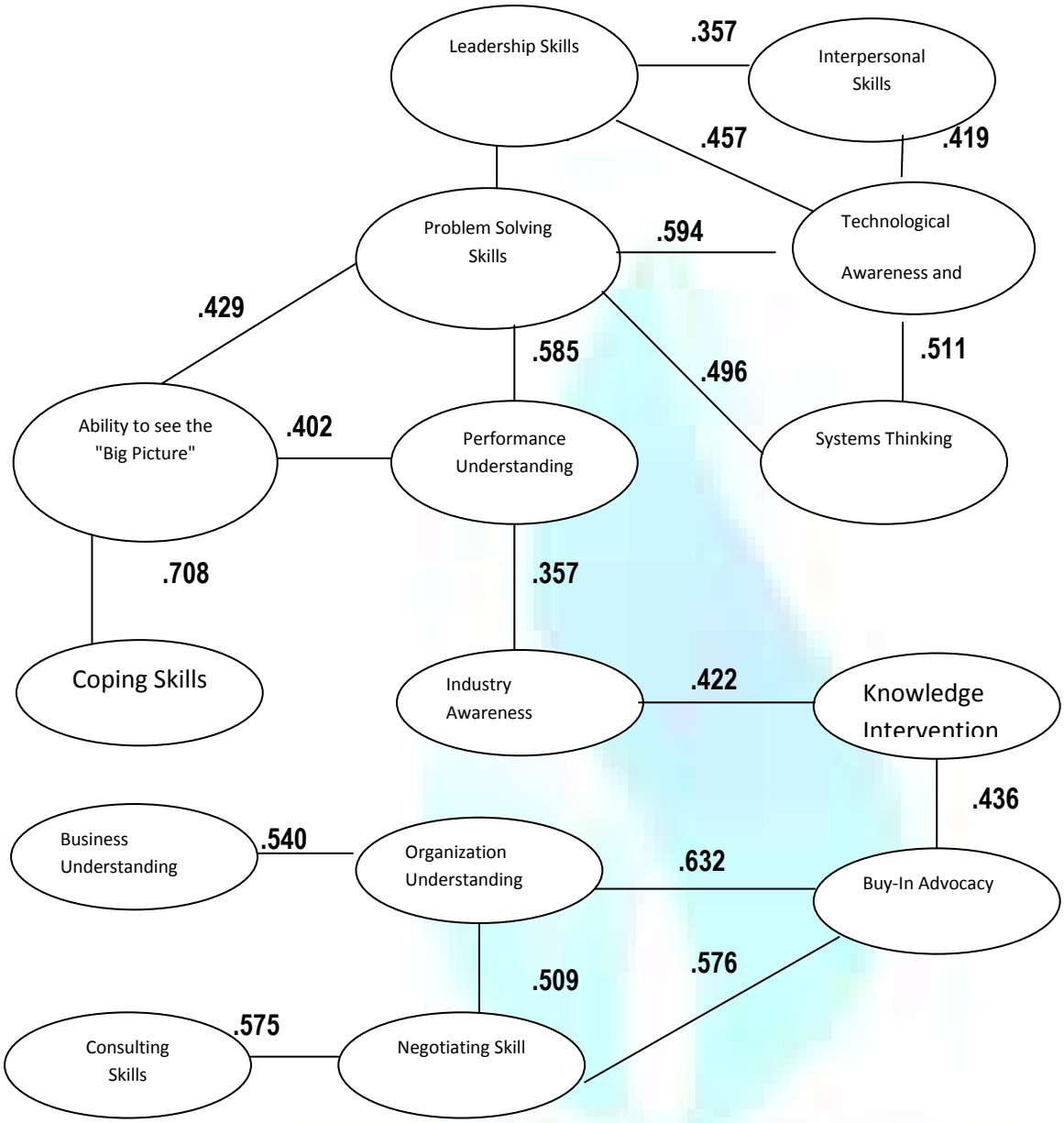
Rank	*Ranking From All Respondents*	*Score*	*Ranking From Human Resource Manager*	*Score*	*Ranking From Industrial Engineer Manager/ Practitioner*	*Score*
1	Leadership Skills	329	Leadership Skills	133	Technological Awareness and Understanding	200
2	Ability to see" Big pictures:"	327	Ability to see" Big pictures:"	128	Ability to see" Big pictures:"	199
3	Problem Solving Skills	324	Problem Solving Skills	126	Organization Understanding	199
4	Organization Understanding	319	.Business Understanding	125	Problem Solving Skills	198
5	Coping Skills	315	Coping Skills	123	Leadership Skills	196
6	Technological Awareness and Understanding	310	Organization Understanding	120	Coping Skills	192
7	Systems Thinking and Understanding	304	Interpersonal Relationship Skills	119	Systems Thinking and Understanding	191
8	.Business Understanding	298	Systems Thinking and Understanding	113	Knowledge of intervention	185
9	Interpersonal Relationship Skills	296	Industry Awareness	112	Buy-In/Advocacy Skills	182
10	Knowledge of intervention	295	Negotiatings/Contracting Skills	111	Negotiatings/Contracting Skills	181
Rank	***Ranking From All Respondents***	***Score***	***Ranking From Human Resource Manager***	***Score***	***Ranking From Industrial Engineer Manager/ Practitioner***	***Score***
11	Negotiating/Contracting Skills	292	Technological Awareness and Understanding	110	Consulting Skills	179
12	Industry Awareness	282	Knowledge of intervention	110	Interpersonal Relationship Skills	177
13	Buy-In/Advocacy Skills	279	Performance Understanding	104	Performance Understanding	174
14	Performance Understanding	278	Consulting Skills	99	.Business Understanding	173
15	Consulting Skills	278	Buy-In/Advocacy Skills	97	Industry Awareness	170

Source of data: result of pairwise comparison of the different competency skill

Table 2 shows that Leadership skills was the top priority skills in manufacturing industries for an entry level Industrial Engineer as ranked by all respondents and by the Human Resource Officer/Manager. The skill is defined as "knowing how to lead or influence others positively to achieve desired work". Hence, Industrial Engineer should be a good motivator since they are the one who will direct and encourage the workers to achieve the target output or production units of the manufacturing company. On the other hand, technological awareness was the priority skill of an Industrial Engineering Manager/ Practitioner. This skill is defined as "the knowledge and use of existing or new technology and different types of software and hardware; understanding performance support systems and applying them as appropriate" (Rothwell, 1999). This reflected that an entry-level industrial engineers will be exposed and require to use software technology in doing their job.

In summary, the top five competency skills are: Leadership Skills, Ability to see the big picture, problem-solving skills, organization understanding and coping skills. The ability to see the big picture means that IE should look beyond details in order to see overarching goals and results. Every organization now a day has vision and mission statement, this enable the company to strategically position their company in the market. Hence, all the works and activities of Industrial Engineers should be aligned to the vision and mission of the company. Another top ranked skill is problem solving skills. Detecting performance gaps and helping other people to discover ways to close the performance gaps in the present and future, furthermore it is also about closing performance gaps between actual and ideal. IE should detect problems in their workplace and be able to solve them by closing the gap between what should be done and what have been done. This problem solving skills is manifested by the quantitative skills of IE such as statistical quality control, forecasting, and inventory management, operation research and others. Understanding the organization is another top ranked skills, IE should view the larger perspective of the organization as framework for understanding and influencing events and change. Coping skills is another top ranked skill which mean knowing how to deal with ambiguity and how to handle stress resulting from change. Change is inevitable, customer always asked for more and better service. In effect, the company should cope with the changing environment in order to survive, likewise, individual and employees should also adapt to the changing environment to become competitive.

FIGURE 3 - RELATIONSHIP DIAGRAM OF THE DIFFERENT COMPETENCY SKILLS



Source: Result of interrelationship of the different competency skills using SPSS version 14

Figure 3 shows the significant relationship of the different competency skills. Leadership skills have significant relationship to problem solving skills with Pearson coefficient of 0.594. It means that the ability to lead and guide the workers also has the ability to close the performance gap of the workers. Moreover, technological awareness and understanding has significant relationship to problem solving skills (r = 0.594) and leadership skills (r = 0.457). The higher the knowledge of use in technology the better it will contribute to close the performance gap and lead the worker. On the other hand, Interpersonal skills has significant relationship with leadership skills (r=.0357) and technological awareness and understanding (r=.419). It reflected that working effectively with others would contribute in leading the workers while understanding the performance support system of the organization. Having a problem solving skills will help Industrial Engineers to understand performance of the organization(r=0.585).They be able to distinguish between the activities and results, recognize their implications, outcomes and consequences in the organization. Problem solving skills will help IE identify inputs, throughputs and outputs of system and subsystem(r = 0.496).This in effect will improve human performance. Ability to look beyond details to see the overarching goals and results will help IE to cope and deal with ambiguity (r=0.708). Understanding the vision, strategy goals and culture of the company has a significant relationship with performance understanding (r = 0.357) and knowledge intervention (r=.422) . Understanding the larger perspective of the organization's setting such as its political, economic and social system with multiple goals has significant relationship with the awareness of inner workings of business function and how business decisions affect the financial and non-financial work results(Organization understanding to Business understanding , r = 0.540). Moreover, understanding the results that stakeholders desire form a process and evaluating the works performed by vendors or outsourcing agents has significant relationship(Consulting Skill to Negotiating Skills , r = 0.575). And lastly, Building ownership or support for change among affected individuals, and other stakeholders will enhance the skill of Organization Understanding (r =0.632) and Negotiating Skills (r = 0.509).

VALIDATION OF THE RESULTED PRIORITY COMPETENCY SKILLS OF THE RESPONDENTS

The resulted priority competency skills were validated through the comparison of the response of a top multinational company. The survey questionnaire filled-up by the company's Human Resource Manager reflected similar priority competency skills as against the respondents' identified competency skills (see table 3).

TABLE 3 – VALIDATION OF THE IDENTIFIED PRIORITY COMPETENCY SKILLS

Respondents' identified priority competency skills	Identified competency skills from a top multi-national company
1. Leadership Skills	1. Leadership Skills
2.Ability to see" Big pictures:"	2. Technological Awareness and Understanding
3.Problem Solving Skills	3.Problem Solving Skills
4.Organization Understanding	4.Ability to see" Big pictures:"
5.Coping Skills	5.Coping Skills
6.Technological Awareness and Understanding	6..Business Understanding
7.Systems Thinking and Understanding	7. Interpersonal Relationship Skills
8.Business Understanding	8. Organization Understanding
9.Interpersonal Relationship Skills	9.Systems Thinking and Understanding
10.Knowledge of intervention	10. Performance Understanding
11.Negotiating/Contracting Skills	11.Industry Awareness
12.Industry Awareness	12.Knowledge of intervention
13.Buy-In/Advocacy Skills	13. Consulting Skills
14.Performance Understanding	14. Buy-In/Advocacy Skills
15.Consulting Skills	15. Negotiating/Contracting Skills

As shown in the above table, it is interesting to note that they have similar ranking for the several competency skills such as leadership skills (i.e., rank no#1), "problem solving skills" (i.e., rank no#3) and "coping skills" (i.e., rank no#5). Other skills such as "technological awareness and understanding" and "ability to see the big pictures" are within the top six of both the respondents and valuator, which implies that the identified priority skills of the respondents are indeed the skills needed by manufacturing firms.

DISCUSSION

The resulted priority competency skills of manufacturing industry could serve as an input to curriculum development. Skill gap analysis was conducted to the different subjects / courses offered under the Industrial Engineering program of University X.

In the third year courses offering of the IE Curriculum, Methods Engineering addresses the twelve (12) competency skills. This is a five unit course where it involves measuring the time and motion of the workers in doing their tasks and the terminal objective of the course is to improve the existing work through elimination of unnecessary movement which lead to reduction of time in doing the task. Problem solving skills and performance understanding had the most addressed competency skills in this particular year level.

In the fourth year courses offering of the IE Curriculum, Strategic Planning course addresses the eleven (11) identified industry competency skills. System thinking and understanding followed by business understanding, problem solving skills and technological awareness and understanding got the most addressed skills in this year level.

In the fifth year courses offering, Industry Engineering Practice addressed all the identified industry competency skills. In this course, the fifth year Industrial Engineering students have 200 hours to work in an industry whether it is manufacturing or service firm as On the Job Trainee (OJT).The Industrial Engineering students will have the opportunity to be exposed in one department of the firm and apply their theoretical knowledge into actual use. At the end of the course, the students will submit a written report about their experience in the firm and proposed improvements in their workplace. The most addressed skills are performance understanding, technological awareness, systems thinking and understanding and business understanding.

Reviewing the resulted industry priority skill, Leadership skill ranked number one was not adequately addressed in the course offering, however it can close the skill gap by providing seminars and training that leads to acquiring leadership skills. Ability to see the big picture also inadequately addressed, it could close the gap by adding more case studies in systems engineering course and in Facilities Planning and Design course.

CONCLUSION

The result of the study, which is the priority skill requirement of the manufacturing industries, reflected that the manufacturing firms have great challenge and high expectations in academic institution specifically to an entry-level Industrial Engineer. For instance, the top ranked competency skills is leadership skills, in this regard, fresh graduate engineer and/or the entry-level engineer must know how to lead and influence others positively to achieved the firm's desired results. Moreover, their position in the manufacturing firm will likely handle several workers, which mean; they will manage the work of others and see to it that the required results are being achieved.

RECOMMENDATION FOR FURTHER STUDIES

A cross sectional studies are recommended in order to validate the resulted significant relationship of problem solving skills to the other competency skills.

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Looking forward an appropriate consideration.

With sincere regards

Thanking you profoundly

Academically yours

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