

# Exploring the Challenges Facing Industrial Engineers in the Employment Market of Trinidad and Tobago: Some Findings

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**Abstract:** In Trinidad and Tobago (T&T), the Faculty of Engineering at The University of the West Indies (UWI) had since the 1980s operated its degree of Bachelor of Science in Industrial Engineering for the Caribbean region. The degree concepts are well-known to the employment market in other parts of the world, a quite-difference situation has been prevalent in T&T and the region over the years. This paper presents the findings of a study that investigated into the challenges facing Industrial Engineers in the employment market of T&T. Empirical findings showed that many respondents were lacking understanding of IE applications in their organisations. It was also not uncommon that T&T organisations hired other non-Industrial Engineers to perform IE-related jobs one hand, and then expected good operational results of these tasks on the other hand. The prevalence of misconstrued perception towards IE would have deteriorated the competitiveness of many T&T organisations. There is a pressing need to break such prevalence by recognising the IE roles and contributions to industry and the society at large. The government and stakeholders in both public and private sectors should work together to break the prevalence chain.

**Keywords:** Industrial Engineering, challenges, employment market, Trinidad and Tobago

## 1. Introduction

The field of engineering is subdivided into several major disciplines. Industrial Engineering (IE) is a people-oriented and customer-focused discipline that stresses the technical and human aspects of quality and productivity. A short definition of IE is “the design of productive processes” (Price, 2007). Turner et al. (1987) contended that the IE and related engineering management disciplines have undergone vigorous development since the concepts were first conceived over a hundred years ago. Over the past few decades, IE has become a fast-growing engineering discipline not only in advanced nations (e.g. the USA, Canada, Japan and Germany) but also developing countries (like, China, Korea, Thailand and Columbia).

According to the Institute of Industrial Engineers (IIE, 2007), IE emerged as a profession as a result of the industrial revolution and the accompanying need for technically trained people who could plan, organise and direct the operations of large and complex systems. The need to increase efficiency and effectiveness of operations was an original stimulus for the emergence of this discipline (Prabhu and Baker, 1986; Vaughn, 1985; Price, 2007). Employment projections have shown

promising IE growth in many countries, like in the USA (SCCC, 2007) and Australia (Prices, 2007). However, a quite different scenario of the IE popularity has been prevalent in Trinidad and Tobago (T&T). Many people including employers and practitioners have been largely underestimating the contributions of Industrial Engineers in their T&T organisations (Parsotan, 2005). In this context, there are at least two pressing issues, including 1) whether the IE roles have been largely ignored, and 2) whether such ignorance would have deteriorated the competitiveness of T&T organisations.

The Industrial Engineering Office of the UWI Faculty of Engineering (UWI) has conducted a study to acquire employers’ views on the challenges facing Industrial Engineers in respective industry sectors in T&T. This paper begins with a brief review of IE concepts and practices, the IE profession and related challenges in T&T. It then presents the main findings of the study. It concludes by underlining the importance of IE along with a discussion on leveraging IE potentials in national development.

## 2. About IE Concepts and Practices

According to the Institute of Industrial Engineers (IIE,

2007), IE is concerned about the design, improvement and installation of integrated systems of people, material, equipment and energy. Traditionally, many people associate the topics of work standards, time and motion study and related activities with IE (Price, 2007). A modern view of IE such as the one exemplified in Salvendy's (2001) Handbook with these subjects contributes less than 5 percent of the IE Body of Knowledge. Nowadays, IE integrates knowledge and skills from several fields of science, namely, technical, economic, human and information sciences (Kwaliteg Management Services, 2007). Specific IE expertise areas include materials handling engineering, operations research, safety and environmental engineering, manufacturing process engineering, method engineering, and quality assurance and control (Prabhu and Baker, 1986; Vaughn, 1985; IEAust, 1993). Table 1 shows the main subject areas in Salvendy's Handbook of Industrial Engineering.

**Table 1.** Main subject areas in Salvendy's Handbook of Industrial Engineering

Subject Areas	Sub-areas
Technology	Computer-Integrated Business Information Technology Manufacturing Engineering Service Technology
Human Dimensions	Ergonomics/Human Factors Organisational Design Work Design
Planning, Design and Control	Engineering Economy Facilities Design Methods Engineering Performance Measurement and Control of Operation Planning and Control Product Planning Quality Assurance
Quantitative methods for decision making	Computer Simulation Optimisation Probability Theory and Methods Statistics for Industrial Engineers

Sources: Based on Salvendy (2001) and Price (2007)

Industrial Engineering "draws upon specialised knowledge and skills in mathematical, physical and social sciences together with principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from such systems." (IIE, 2007). IE practices focus on the design of products, processes and systems, and cut across other major engineering disciplines and associated engineering management (UWI, 2007a). They stress operations improvement, innovation, analysis, design and optimisation of industrial systems that apply to public and private organisations and to energy, manufacturing and service-oriented sectors (e.g. hospitals, banks and insurance). A consistent theme of IE is to encompass a broad scope and look at systems integration (UWI, 2007a).

### 3. About IE Profession and Popularity

IE is a dynamic and rapidly developing profession to provide a wide range of career opportunities. The profession comprehends knowledge and professional skills in applying scientific analysis, technical design, management techniques, financial appraisal and human relations principles in order to improve quality, productivity, investment and human development in operations (Kwaliteg Management Services, 2007). Industrial engineers are the professionals trained as productivity and improvement specialists. The wide base of IE skills and applications leads to flexibility and allows the industrial engineers themselves to act, make decisions or solve problems by drawing from various areas of knowledge (Parsotan, 2005).

According to the California Occupational Guide (2007), industrial engineers serve as a bridge between management goals and operational performance. They have specific job descriptions and working areas of considerable variation, in fields, which are not traditionally considered to be engineering, thereby making IE a most dynamic and versatile engineering discipline. Table 2 depicts the roles of Industrial Engineers abstracted from different sources.

**Table 2.** Roles of industrial engineers in industries

Industrial Engineers	Sources
"...figure out how to do things better. They engineer processes and systems that improve quality and productivity. They work to eliminate waste of time, money, materials, energy, and other commodities. ... save companies money."	Institute of Industrial Engineers (IIE, 2007)
"...deals with the solution of the problems that occur during the phases of planning, design, implementation and development in organisations, which produce goods or services. ...especially the efficient use of scarce production resources and the development of methodologies and techniques to increase quality in production are its basic functions."	Middle East Technical University (METU, 2007)
"...determine the most effective ways to use the basic factors of production... to make a product or to provide a service. ... concerned with increasing productivity through the management of people, methods of business organisation and technology."	Sloan Career Cornerstone Center (SCCC, 2007)
"...develop and implement plans to maximize the efficiency and effectiveness of an organisation. ...look at how people, machines, energy, resources, and information are used to accomplish management's goals and devise ways to improve those methods."	The National Academy of Engineering (NAE, 2007)

Price (2007) identified two issues for the professional engineering labour force with reference to Australia. Firstly, the service sector has a continuous growth that affects the attractiveness of traditional engineering careers (such as Mechanical, Electrical and Civil engineering) compared to career paths specifically oriented toward the service sector (such as retail, finance

and management). Secondly, many of businesses involved in traditional engineering (such as electricity, railways, telecommunications) have been changing dramatically, and many engineers have engaged in seeking efficiency and productivity improvements for these businesses. These are clearly roles for which Industrial Engineers are trained (Price, 2007).

Nowadays, increasing complexity and scarcity of resources in industry, service organisations and government have led to ever broadening employment opportunities for Industrial Engineers (IIE, 2007). Many companies would adopt various management philosophies of continuous improvement in response to the increasingly competitive markets. In the USA, for instance, IE becomes one of the largest engineering professions with an estimated 200,000 practitioners (IIE, 2007). According to the U.S. Department of Labour, Bureau of Labour Statistics, industrial engineers are expected to have employment growth of 20 percent over the projections decade, faster than the average for all occupations (SCCC, 2007).

One of the key issues for any potential student considering taking up a degree is the international recognition of that degree on completion (Price 2007). Pursuing IE has already become a popular engineering degree choice at universities in North America (like the USA and Canada), Europe (like Germany and Scandinavia) and Asia (like Japan and Korea, Taiwan, Indonesia and Hong Kong). For instance, over 100 engineering faculties at universities in USA are offering degree programmes in Industrial Engineering that are accredited by the Accreditation Board for Engineering and Technology, Inc (ABET) (SCCC, 2007).

#### 4. IE Challenges in T&T

Recently, employment markets for Industrial Engineers have been picking up significantly in many countries (like the USA, China, and Columbia) and regions (like South America and South East Asia). For instance, The US Department of Labour has forecasted approximately 12,000 openings per year for industrial engineers in the next decade, which is more than three times the number currently being graduated (Purdue University, 2007). Notwithstanding the popularity of IE in other parts of the world, a quite-different scenario of IE was found in Trinidad and Tobago (Parsotan, 2005).

Many employers are unaware of the importance and contributions of IE leading to an unusual lagging on the employment market in T&T. For instance, during the period from October 2006 to March 2007, there were 248 engineering vacancies advertised in the Express Newspaper which is one of the most popular newspapers in Trinidad and Tobago. Despite 47 vacancies being applicable to any engineering disciplines, only 16 positions were open to?? IE graduates. The others include 63 for Mechanical, 41 for Civil, 40 for Electrical, 20 for Chemical engineering graduates, and

21 for another related graduates (e.g. surveyors and geoscientists). Job advertising for Industrial Engineers by name is rather rare in T&T. Evidence showed that the job descriptions for many vacancies, although not specified, included the duties and/or areas bestowed to Industrial Engineering (Price, 2007).

Moreover, if using the engineering enrolments and throughput rates as an indicator, the IE programme and number of its graduates remained at a small range of growth since its introduction in 1979 at UWI. The IE programme had its first batch of graduates in 1982. The total number of IE graduates represented less than 5 percent of the total number of nine Engineering graduates programmes over the period of 1982-2006 (UWI, 2007b).

#### 5. An Empirical Study

In order to investigate challenges facing industrial engineers in employment market in T&T, an empirical study by the UWI Industrial Engineering Office was undertaken in 2007 to acquire employers'/practitioners' views on the issues. Collection of data was accumulated by questionnaire surveys and telephone follow-ups. The questionnaire comprised of two sections. The first section asked questions about the company profile in terms of 1) nature of business and 2) years of establishment. The second section acquired respondents' views on engineering employment and the roles played by industrial engineers in their organisations. Respondents were asked to 1) provide the number of employees being hired as Industrial Engineers and associated positions, and 2) elaborate the reasons for not hiring Industrial Engineers for their organisations.

According to the 2006 TTCIC's Trade Directory, the Trinidad and Tobago Chamber of Industry and Commerce provided the listings of 741 companies in three broad divisions, including 152 manufacturers, 263 importers/exporters and 326 service providers (TTCIC, 2006). Some of the listed companies belong to more than one category. For instance, many manufacturers and service providers were also exporters and importers. After eliminating the duplicate records in the listings, a total population of 450 companies was based. A proportional stratified method of sampling was used in the survey. For facilitating the analysis of findings, a ratio of 2:1:1 was arbitrarily used for choosing targeted organisations from the categories of manufacturers, importers/exporters and service providers, respectively. A sample size of 90 companies was determined, and the proportion of selected companies is given in Table 3.

#### 6. Some Findings

##### 6.1 Response Rate

The questionnaires were mailed to senior executives (such as general managers, human resource managers, operations managers, and plant managers) of the selected companies to complete. Follow-up telephone enquiries

were done to those who have not returned the questionnaires. Of 90 questionnaires, 54 valid replies were obtained yielding a response rate of 60 percent. Among these replies, 24 were completed questionnaires with a successful rate of 44.4 percent. There were 30 incomplete questionnaires, and of which, most respondents argued that their companies are not manufacturing-oriented and they have employed no Industrial Engineers. Table 4 depicts the nature and number of the survey responses received.

**Table 3.** Determination of sample size

Category	No. of Listed Companies	Actual Proportion	Ratio Adopted	No. of Companies Selected
1. Manufacturing	152	21.5%	50.0%	45
2. Importers /Exporters	263	35.5%	25.0%	22
3. Service Providers	326	44.0%	25.0%	23
<b>Total:</b>	<b>741</b>	<b>100%</b>	<b>100%</b>	<b>90</b>

**Table 4.** A summary of response rate

Nature of Response	No. of Questionnaires & Percentage
Complete	24 (26.7%)
Incomplete	30 (33.3%)
No response	36 (40%)
<b>Total:</b>	<b>90 (100%)</b>

### 6.2 Statistics of IE Employment

Out of 54 returned questionnaire (including 30 incomplete ones), it was found that 39 companies (i.e., 72.2%) indicated that they have not hired any industrial engineers. Only fifteen companies reported that they hired Industrial Engineers (9.3%) and/or of different titles (18.5%). Table 5 shows the survey statistics of IE employment. Of which, most industrial engineers and associated personnel work in manufacturing industries and/or the energy-related companies with manufacturing operations. Only one (1) importer and two (2) building service providers hired IE-associated personnel (rather than Industrial Engineers by name).

**Table 5.** Survey statistics of IE employment

Industry Sectors	No of Companies Which Hired:			
	Industrial Engineers	Other titles	None	Total:
1. Manufacturing Sector (include energy)	5	7	11	23 (42.5%)
2. Import/Export Sector (include agribusiness)	0	1	11	12 (22.2%)
3. Service Sector*	0	2	17	19 (35.2%)
<b>Total:</b>	<b>5 (9.3%)</b>	<b>10 (18.5%)</b>	<b>39 (72.2%)</b>	<b>54 (100%)</b>

\*Remarks: include building, financial, healthcare, hospitality, IT, media, transport and shipping.

As reported in the completed questionnaire, all IE employment were found with companies of over ten (10) years of existence. Besides, larger companies (i.e., 101 to 200 employees and more than 200 employees) seemed to hire more IE and/or associated personnel than small businesses (i.e., 1 to 50 employees and 51 to 100 employees) (see Table 6)

**Table 6.** Company's size and year of establishment and IE employment

	No of Companies (n = 24)	No of Industrial Engineers Hired	IE Personnel with Other Job Titles	Total No. Hired
<b>Size of Company</b> (no. of employees):				
1 to 50	3	0	1	1
51 to 100	7	0	2	2
101 to 200	4	2	3	5
> 200 people	8	3	4	7
<b>Year of Establishment:</b>				
1 to 10	2	0	0	0
> 10 years	22	5	10	15
<b>Total:</b>	<b>24</b>	<b>5</b>	<b>10</b>	<b>15</b>

Findings also showed that many manufacturing companies with import/export business or providing

services were adamant about IE in their organisations. Most importers/exporters and service providers were unsure of how IE could benefit their business and operations. For instance, seven (7) importers/exporters explained that there was no need for hiring any engineers (including Industrial Engineers) in their marketing-oriented operations. Besides, another seven (7) financial organizations (such as banks, insurance and accountant companies) replied that IE was not directly related to their business. Three (3) hospitals, two (2) hotels, one (1) shipping firm and one (1) radio station shared the similar view. On the other hand, those building and construction organisations participated in the survey also reported that they would hire strictly Civil or Construction Engineers rather than Industrial Engineers because of the nature of their works.

### 6.3 IE Applications in Industries

Respondents were asked to indicate their assessments of IE applications in their organisations with respect to a given list of 13 IE areas. A 5-point Likert scale was used, with 1 representing strongly disagree and 5 strongly agree on these skills and techniques. As summarised in Table 7, the five (5) most areas of IE applications were Plant location and layout design (i.e.

mean = 4.04; SD = 0.69), Production planning and control (i.e. mean = 3.83; SD = 0.76), Operations research (mean = 3.75; SD = 0.94), Project management (mean = 3.71; SD = 0.86) and Quality control (mean = 3.63; SD = 0.88). Nevertheless, Engineering economics and financial management (mean = 3.04; SD = 0.95) was

the least IE application area as commented by respondents. There were high percentages of respondents who chose neutral (i.e. a Likert-scale of 3), indicating that they were unsure of the potentials of IE applications.

**Table 7.** Ranking of IE applications in industries

Areas of IE Applications:	Mean* (N = 24)	Standard Deviation	Ranking
1) Plant Location and Layout Design	4.04	0.69	1
2) Production Planning and Control	3.83	0.76	2
3) Project Management	3.75	0.94	3
4) Operations Research	3.71	0.86	4
5) Quality Control and Inspection	3.63	0.88	5
6) Lean Operations	3.58	0.88	6
7) Applied Statistics to Problem Solving	3.58	1.02	7
8) Materials Management and Inventory Control	3.54	0.93	8
9) Product Design and Development	3.54	0.98	9
10) Industrial Database Design	3.46	0.83	10
11) Work Study and Ergonomics	3.33	0.92	11
12) Simulation of Industrial / Business Processes	3.25	0.79	12
13) Engineering Economics and Financial Management	3.04	0.95	13

\*Remarks: Mean scores were computed based on 5-point Likert Scale; where 1 = Strongly Disagree, 5 = Strongly Agree

#### 6.4 Challenges and Roles of Industrial Engineers

Respondents were then asked to express their level of agreements on five (5) given statements regarding the challenges and roles of industrial engineers in T&T. It was shown in Table 8 that many respondents perceived that Industrial Engineers could contribute to attain cost savings (mean = 3.79; SD = 0.66) and increase operational efficiency (mean = 3.58; SD = 0.93) for their respective companies. Comparatively, many respondents have certain reservations on whether Industrial Engineers could be the company's assets (mean = 3.46; SD = 1.25), be the problem solvers (mean = 3.38; SD = 0.88), and the all-round engineers (mean = 3.04; SD = 1.20).

**Table 8.** Challenges and roles of Industrial Engineers

Roles of Industrial Engineers	Mean Score* (N = 24)	Standard Deviation
1. Are problem solvers	3.38	0.88
2. Are all-round engineers	3.04	1.20
3. Contribute to increase the operational efficiency	3.58	0.93
4. Contribute to attain cost savings for the company	3.79	0.66
5. Are assets to the organisation	3.46	1.25

\*Remarks: Based on 5-point Likert Scale (1 = Strongly Disagree, 5 = Strongly Agree)

#### 7. Discussions

Many targeted respondents disregarded the mailed

questionnaire. Among those who responded to the survey, analysis of findings indicated that many respondents misinterpreted "Industrial Engineers" as those who used this job title. Other than the obviously misconstrued perception that IE is associated primarily with manufacturing, they were unsure of the scope and extent of IE applications in their business and operations. Besides, the study showed that respondents in the manufacturing sector hired more other engineers than industrial engineers. Many non-manufacturing companies do not see the need for hiring any industrial engineers and associated personnel in their organisations. As a result, the findings showed that only few companies hired Industrial Engineers.

There are at least two (2) implications. Firstly, many employers/practitioners have underestimated the roles and contributions of IE in their organisations. They hired non-industrial engineers or non-IE personnel to perform IE tasks on one hand, and commented that those hired were lacking practical skills and knowledge to accomplish IE tasks on the other hand. Secondly, there were not enough industrial engineers who could meet the market need. In other words, insufficient supply of qualified industrial engineers was attributable to such 'imbalanced' scenario. A respondent also shared a strong view that 'good industrial engineers are hard to come by'. Therefore, Industrial Engineers and IE graduates should equip themselves by being completely knowledgeable about IE and being able to defend against the false claim of limited IE applications in T&T. They

should perform IE jobs optimally and manage other engineering personnel to perform jobs with a goal to achieve operational efficiency that organisations need.

The survey findings also showed that larger and established companies would hire more Industrial Engineers and associated personnel. The versatile applications of IE could be an asset for companies irrespective of their business nature, size and locations. Therefore, employers/practitioners should critically look into the capabilities of hiring Industrial Engineers and how they have aided in their operations advancement.

## 8. Conclusion

The roles of IE are changing and the need for Industrial Engineers around the world is growing. The IE skills and methodologies are applicable to different industrial systems found everywhere such as manufacturing plants, services companies (e.g. hospitals, banks, insurance, etc) and government organisations. Empirical findings showed that many respondents were lacking understanding of IE applications in their organisations. The inappropriate impressions, which employers held of Industrial Engineers, are affecting the IE employment and hindering the competitiveness of many organisations in T&T. It would be questionable for employers who hire non-industrial engineers to perform IE tasks on one hand and then expect good operational results of these tasks on the other hand. There is a pressing need to break such a prevalence by restating the IE roles and contributions to industry and the society at large.

The T&T Government has launched the vision 2020 planning initiative to transform the nation into a developed society by the year 2020. Many nations (like the USA, Germany, China and Japan) have been developing IE disciplines for fostering national development and growth. If Trinidad and Tobago is to follow in the footsteps of these nations, more Industrial Engineers and IE graduates should be produced to meet the development need of the country. The Government and policy makers should invest in IE education and training to meet the industry needs. Open forum, regional and international conferences could be conducted to foster the awareness of the manifold of IE applications. The university sector also plays a pivotal role to ensure the anticipated growth in IE workforce for the nation be met with sufficient supply of qualified IE graduates for years to come.

IE is an important branch of engineering that is concerned about the analysis, design and optimisation of integrated industrial systems that stress operations improvement and enterprise development (IIE, 2007). Industrial Engineers are the core driver to attain the development of nation status. This paper provides some factual account of challenges facing Industrial Engineers in the T&T employment market. In order to revitalise the situation, future studies and analyses of IE applications should be performed in the firms and industry levels,

specifically addressing how would IE contribute to organisations and national developments. Cases studies are also suggested to investigate into the challenges of IE not only in T&T, but also in the wider regional context of the Caribbean.

## References:

- California Occupational Guide (2007), *Occupational Guide on Industrial Engineers*, Number 3, available at: <http://www.calmis.cahwnet.gov/file/occguid/ENGIND.HTM> (Cited 1 April 2007)
- IEAust (1993), *National Competency Standards for Professional Engineers*, Institution of Engineers, Australia, ACT, March.
- IIE (2007), *Institute of Industrial Engineers*, available at <http://www.iienet.org/> (Cited 1 July 2007)
- Kwaliteq Management Services (2007), *Management Service and Industrial Engineering Consultants - Profile*, available at: <http://www.kwaliteq.co.za/>, (Cited 1 April 2007)
- METU (2007), *Industrial Engineering Department*, Middle East Technical University, available at <http://www.ie.metu.edu.tr/>, (Cited 1 April 2007)
- NAE (2007), *Engineer Girl*, The National Academy of Engineering, available at: <http://www.engineergirl.org/nae/cwe/egmain.nsf>, (Cited 1 April 2007)
- Parsotan, A. (2005), *Employers' Perception of the Role of Industrial Engineering in Trinidad and Tobago*, Final-year Project Report (unpublished), Department of Mechanical and Manufacturing Engineering, The University of the West Indies, April.
- Prabhu, V, and Baker, M. (1986), *Industrial Engineering, Techniques for Improving Operations*, London: McGraw Hill.
- Price, J.W.H. (2007), *Industrial Engineering and Engineering Management in Australia*, <http://www.iie.com.au/Resources%5CArticleDocs%5Cbeieem%20paper.pdf> (cited on 9 July 2007)
- Purdue University (2007), *About IE: Industrial Engineering*, available at [https://engineering.purdue.edu/IE/resources\\_for/Prospective\\_Students/about\\_IE\\_html](https://engineering.purdue.edu/IE/resources_for/Prospective_Students/about_IE_html), (Cited 1 April 2007)
- Salvendy, G. (2001)(ed), *Handbook of Industrial Engineering: Technology and Operations Management*, 3rd Edition, New York: John Wiley.
- SCCC (2007), *Industrial Engineering Overview*, Sloan Career Cornerstone Center, available at [www.careercornerstone.org](http://www.careercornerstone.org) (Cited 1 April 2007)
- TTCIC (2006), *TTCIC Trade Directory 2006*, The Trinidad and Tobago Chamber of Industry and Commerce, available at: <http://chamber.org.tt/>, (Cited 1 April 2006)
- Turner, W.C. Mize, J.H. and Case, K.E. (1987), *Introduction to Industrial and Systems Engineering*, New Jersey: Prentice-Hall.
- UWI (2007a), *Information Brochure: Industrial Engineering*, Industrial Engineering Office, University of the West Indies, Trinidad & Tobago, Version 3, May

UWI (2007b), *Faculty of Engineering Statistics*, The University of the West Indies, St. Augustine Campus, April.

Vaughn, R.C. (1985), *Introduction to Industrial Engineering*, Third Edition, Ames, Iowa: The Iowa State University Press.

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