The Roles of Engineering Management in Developing Countries

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Abstract:

Observations of professional engineering in developed and developing countries reveal that professional skills are significantly higher in developed countries. Some of these skills included with high regards are particularly, organizational skills, financial skills and knowledge of advance engineering materials and techniques. It has been illustrated and understood that the cost of engineering services is higher in developing countries than in developed countries, which is explained by the lack of professional engineering skills. The differences between engineers and engineering management between developed and developing countries have also been discussed. In addition, the paper discusses the importance of engineering management to enhance the overall success rate of the given developing country's economy, which places these nations in a more realistic competitive view in regards to the economy of a developed country.

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Developing Country:

A developing country is defined as a country with a low income average, a relatively undeveloped infrastructure and a poor human development index when compared to the global norm. The application of the term “developing country” to all of the world's least developed countries could be considered inappropriate. In the many cases of poor countries, where there is no improvements related to their given economic situation and their experiences in staggering periods of economic decline, this term of “developing,” does not apply. The term "developing country" often refers mainly to countries with low levels of economic development, but this is usually closely associated with social development, in terms of education, healthcare, life expectancy, and etc. The development of a country is measured with statistical indexes such as income, the rate of illiteracy, and access to water. The UN provides a compounded indicator using these lists of statistics, to create, a "human development index" which gives a sense of how developed countries are.

Developing countries are in general, countries which have not achieved a significant degree of industrialization relative to their populations, which are also associated with a low standard of living. There is a strong correlation between low income and high population growth, both within and between countries. Although a good part of the world strives for increase of development, the term itself is criticized by those who think of the ideas as being too centered on Western countries. The term implies a direction and a movement that the countries must follow; it implies inferiority with respect to the developing countries.

According to different theories the rational of underdevelopment with these underdeveloped countries include:

- Low saving which may lead to low investment according, but large amount of saving and investment still does not imply strong development

- Intrinsic attitude and aptitude, real or used justification
  *Attitude and culture of the people
  *Aptitudes and behavior of the elites and leader
- Legal structures and institutions
  *A breakdown in the rule of law
  *High corruption

- Extrinsic factors, real or used as justification
  *Geopolitical or commercial interest that it creates compared to other countries
  *Place of the country in a historical and cultural system
  *Lack of interest in and comprehension for the specific dynamics of a nation, by multinational companies

Developing countries play an increasingly important and active role in the world because of their numbers. They are becoming more important in the global economy, and are increasingly looking to trade as a vital tool in their development efforts. These particular countries are a highly diverse group, often with very different views and concerns. Engineering management plays a critical role in improving the country. In other words, a developing country is such that it does not apply very well the significant characteristics of engineering management. The quality of engineering management is a method in which we can differentiate between a developed country and a developing country. There is no way for a developing country to stand up to the challenges and share global economics and innovation without well applying engineering management characteristics in their industries. Engineering management involves enhancement in these developing counties due to their economics and industries and hence enhancement due to their role in the global evolution. Initially, before emphasizing the importance of the role of engineering management, we should have an understanding the differences in engineering quality between developed and developing countries, and then explain the importance of engineering management characteristics.

Engineering in Developed and Developing Countries:

Observation of professional engineering in developed countries and developing countries reveal that professional skills are significant higher in developed countries, particularly organizational skills and knowledge of advanced engineering materials and techniques. It is also observed that the cost of engineering services is high in developing countries; in many instances greater than in developed countries. The lack of professional engineering skills contributes significantly to the high costs of development. Engineers in developed countries compete for work by strategy of improving their skills to improve their productivity and hence financial rewards. By selecting improving their skills levels, engineers in developed countries can obtain higher salaries and also expect a productivity gain from their recruiting firm. These gains seem to be much greater than salaries savings predicted by labor market supply and demand pressure. Therefore, the overall returns from investment in engineering activities in developed countries appear to be significantly higher than the returns from engineering activities in developing countries. To understand why this occurs we need to appreciate the differences in the definition of the engineer and engineering amongst developed and developing countries.

Engineers in developed countries:

An engineer in a developed country is a person that solves problems by organizing cost-effective solutions, that provides solutions with predictable cost, timescale, and performance. Engineering relies as much on the confidence of clients as it does on the abilities of engineers to provide solutions. The engineer's role is first to understand the client’s or firm’s problem and to think about possible solutions. Often the most difficult part is simply identifying the problem. Once the problem has been defined and solutions proposed, the engineer then has to persuade the client to provide enough resources (usually money), and to implement a solution. This is often competitive amongst other engineers; he or she must aim for the cheapest feasible solution and may have to negotiate with the client.

Engineers’ salaries in developed countries are naturally affected by competition for paid work. In fact, there are many other rewards that motivate engineers in developed, industrialized countries. Factors such as the prestige of the organization they work for

accounts for more than just salary. Another reward for many engineers is the ability to build something that outlasts them, something that they will be remembered by. When it comes to competing in the market place however, engineers have the flexibility to compete not only on the basis of salary package, but also by improving their skills. They can offer a higher marginal product and hence increase their salary potential. This strategy pays off for employers as well.

There are several ways we can see evidence that engineers are adopting the skills improvement strategy in the market place in developed countries:

- In a firm in a developed country, we see systematic organizational learning and skills improvement strategies. Many firms have systematic training for new engineers whom they recruit and strategies for exchanging experience and expertise within the firm

- Many engineers pursue postgraduate degrees part-time, particularly MBAs that build their skills in management and finance.

- Engineers in developed countries describe how they have never stopped learning during their entire working lifetime. In fact, a rigorous requirement for continuing learning has now become a part of the annual re-accreditation process for practicing professional engineers in most developed countries. Interestingly, one of the key attributes now required from engineering education in developed countries is an ability to undertake self-directed lifelong learning. These recent developments reflect similar incentives for skill improvement. The emergence of global agreements recognizing common requirements for engineering accreditation and registration demonstrates the similarity of professional engineering practice in developed countries.

- Skills acquisition is also influenced by clients. Many clients in developed countries are well aware of technological developments and will sometimes specify the type of engineering solution they want. Many engineers acquire new knowledge directly as a result of the work they do for their clients. Many clients will insist on quality assurance, and will hire experts to ensure the engineers' work is up to modern standards. Hence the level of technical awareness of the client also can influence skill acquisition by engineers.

- Engineering product suppliers in developed countries, whose market consists mainly of engineers, usually devote considerable resources to subsidized training programs as part of their product marketing strategies. This includes subsidized supply of products and services to engineering schools to create awareness of their products. The net result is a significant contribution to engineering workforce skill enhancement.

Engineers in developing countries:

Engineering affects almost every part in developing countries from the remotest rural villages to the heart of the high establishment. The cost of engineering in developing countries is surprisingly high, whether it is building construction, water and electricity supply or ship building. It is observed that costs in developing countries are as high as or higher than in many developed countries. This comes as a surprise because the low pay rates for both skilled and unskilled labor in developing countries suggest that engineering costs should be significantly lower. The World Bank has reported that developing countries have a high cost operating environment for business, due to excessive regulation that forces companies to pay fees, charges and 'nuisance payments' to officials. When this is coupled with the high costs of engineering services compared with developed countries, it is no surprise that investment levels are also low.

The high costs of engineering projects in developing country can be explained by the ineffective management that manipulates and controls the industry and economy of the country. Developing countries need an effective management in order to move up and to share the global innovation. Effective management means having the greatest probability to achieve a desired result, adjusting its own behavior to the fundamental consistency or congruity of people and situation, and well utilizing its recourses and the appropriate options. Engineering management is a great example of an effective management. The efficiency of engineering management refers to the type of the performance that engineering managers do in industries and firms. They perform the work involves the perfection of utilizing resources (eg., energy, agriculture, money, human efforts, etc) with combination of two types of work such as: 1- Management work that involves planning,

organizing, controlling and leading. 2- Technical work that specializes in non-management work and scientific jobs. Developing countries fail to spot the efficiency in management, and fail to apply the characteristics of engineering management in economics and industry. So, what is engineering management? Why is it different?

Engineering Management:

Engineering Management bridges the gap between engineering and management. It involves the overall management of organizations with an orientation to manufacturing, engineering, technology or production. Some people tend to say that "management is management". This is not true; there are significant differences between engineering management and any other type of management such as operational management. Some of these differences are explained here:

1. Engineering managers are associated to create something new or to improve an old product or a current method of a process. They are oriented to innovation and changes. Operational managers, by contrast, deal with more predictable, well-defined tasks. They emphasize in assuring adherence to procedures and plans. Therefore, the engineering manager seeks to encourage and create an atmosphere that is conductive to creativity, innovation, and changes; the operational manager seeks to sameness.
2. Engineering managers usually deal with one-time activities. Once the project or task is done, another kind of project will be assigned. Operational managers, on the other hand, deal with routines that repeat themselves periodically.
3. The costs of one-time activities are difficult to estimate ahead of time. Estimates of operational costs can usually be predicted based on hysterical data. Since engineers are apt to deal with first-time endeavors and creative or innovative tasks, a more dynamic and flexible planning philosophy is always require to reduce the cost and error estimation.
4. Operational managers do not have enough background to develop intuitions about which of the possible technologies now on the horizon are apt to advance further. They cannot judge the merits of revolutionary changes in technology. Engineering managers, on the other hand, have the ability to understand the technology, to

evaluate its productivity, to analyze its strengths and weaknesses, and then to predict its future and predict the new, needed technology. Technological intuition and innovation are the areas engineering managers can and should excel at.

Engineering leaders with technology savvy and management perspectives are much needed. Their characteristics are not only leadership skills like operational managers, or business perspectives like marketing managers, but also they have a good knowledge in technology (see figure 1). The combination of technology know-how and business savvy is powerful. If engineering manager does only what a typical non-technical manager does (operational manager), then the engineering manager does not earn his or her keep.

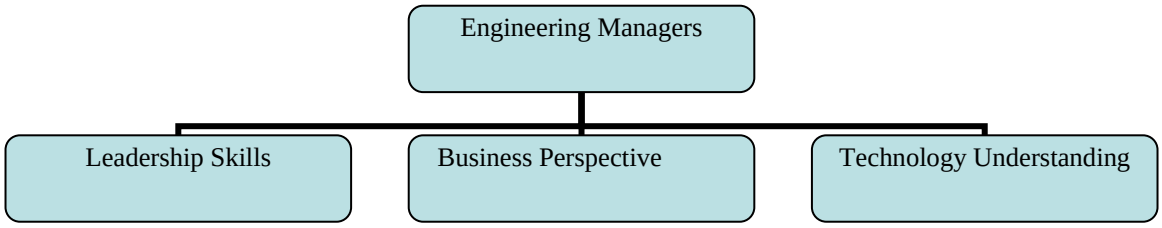

Figure 1 shows the unique characteristic of engineering managers in combining leadership skills, business perspective and technology understanding

Engineering management is characterized with some principles and functions. Engineering managers who well apply these principles are very valuable. These principles are discussed briefly here:

a) **Planning:** An important function of engineering management to anticipate future events and making preparations. It involves decisions in defining who, where, when and how the project or the course has to be done. Planning is made by changes in our world; companies in developed countries have to introduce new planning design to satisfy the rapid change in technology, environment, and organization. There are two types of planning:

   1. Strategic Planning which defines the firm's objectives, mission, and goals, market capitalization, business standing, and ranking market share. It assures that the firm applies its recourses perfectly and properly and it focuses on identifying the firm's future activities.

2. Operational Planning which defines the specific tactics and action needed in order to achieve and accomplish the objective specified by the strategic planning. It also assures that the firm applies its recourses effectively.

b) **Organizing:** It defines and groups the activities required, establishes the responsibilities for people who will carry them out, and sets the working relationship among them. It is an efficacious function to achieve the objective perfectly. It organizes the performance of the employees in the most efficient ways.

c) **Staffing:** It secures the services of people with the knowledge and skills to carry out the necessary activities. Success in this function is critical; Managers who can identify and attract good people are well on the way to success. It is the engineering managers responsibility to understand the need of the organization and find people who matched the qualification requires. In addition, he or she should put the right people together and keep the wrong separated so the firm can enhance its goals and objectives properly.

d) **Motivating:** It offers the inducements and incentives to individuals in the group to get them putting their best efforts. The main purpose of the technical group (staff) in engineering firms is problem solving. Since the end result of problem solving is primarily ideas, new concepts, new products, the major productive force is the minds of this staff. The ultimate degree of success that a technical organization achieves depends on the creativity of its personal. Engineer managers in developed countries are responsible to motivate their people to innovation. In contrast, engineer managers in developing countries are assuming the role of followers, and are defending their position according to their competitive cards in developed countries. This behavior explains the failure of engineer managers to motivate their people into creativity.

e) **Communicating:** It is to create understanding and acceptance by conveying facts, ideas, and all required information between the group members. This function is varied between developed and developing countries. In developed countries excellent of communication skills is required for engineers and managers. Communication may be in face-to face talk, phone conversation, emails, video-conference, staff meeting, memos, letters, and web-posting. In developing countries, on the other hand, there are usually lacks of communications between members in the firm. They may not even

have internet, or emails to communicate, which are very important nowadays for fast communication

f) **Measuring/Controlling:** It evaluates and analyzes whether or not the activities of the group are accomplishing the desired purposes and goals, and assures that the firm well utilize its resources applies them perfectly and properly. Good engineering managers are engineers who practice the specific tasks of controlling which are:

1. Defining the objectives and setting the standard.
2. Comparing actual performance with the standards set.
3. Analyzing the difference or determining the cause of variance.
4. Applying correction on the actual performance if needed.

Measuring controlling are criteria resulted by work measured and evaluated. It is criteria that classify the performance into excellent, average, and bad. It is established in the form of how well is the performance of the employees as imposed by the company management, the customers and the marketplace. On the other hand, controlling is to organize the employees' performance and to control the time required for the task.

g) **Leading:** an important function in engineering management. It is the ability of the engineering manager to guide, control, and direct the efforts of his/her employees to attain the firm goals and objectives. Leading involves many activities which such as decision and choosing alternatives related to projects, technology, financial resources and people. A good leadership defined as the ability of the individual to induce the other to produce the intended results. Leading is the implementing force behind all of the other management functions. In other words, a good leader is the one who guide the organization to well apply all the other engineering management function appropriately and perfectly. Engineers with management/leadership skills have superior opportunities to add value for the organization

Engineering management and economics:

Since the beginning of the 20th Century, the technological development has been improved extremely rapidly and has created a global business environment. Competition, innovation and marketing edge are key to economic and organization success. In developed countries it is important that corporate and market knowledge exists at every

level, where engineering management has to work towards the ultimate goal of product success and market capitalization in order to improve the economy of the country. Developed countries usually have economic systems based on continuous, self-sustaining economic growth. Economy is a key element that allows you to distinguish between developed and developing countries. It is strong and stable in developed countries as compared to being poor and unstable in developing countries. There are several reasons that contribute to the decreasing in quality of the economy in developing countries, such as: unstable politics, war, low level of education and limited resources. Economic awareness will help the developing country in the following areas:

- ***Increases in the capital income of the country***

  Capital income (often called working capital) in economics means the amount carried in cash, account receivable, and inventory that are available to meet day-to-day operating needs. Therefore, the country will decrease their loans, increase the cash flow so they can invest in other area, and suit their practical needs.

- ***Enhancing the quality of life of the given population***

  Durability and strength in the economy provides the country with money and power so the people live richly and contently. There is a huge difference between the quality of life in a developed country such as the US and in developing countries such as Syria. Typical US citizens enjoy luxuries such as cars, vacations, permanent jobs, and of course stable politics. In addition, strong economy enhances and increases the performance of industry, manufacturing and businesses; therefore, the percentage of unemployment is very low.

- ***Enhancing social stability***

  The improvement of the social life of a developing country is directly related to a prosperous economy. For example, Middle East suffers from the unstable social life because of poor economics resulting from situations involving wars and unstable politics, even though it is one of the richest regions in the world in terms of recourses. Having a strong economy in the Middle East

will help contribute to the resolution for the social related issues that are occurring.

- ***Improvements of literacy***

  Education becomes a priority when economic needs are met and surpassed; the rate of supply for literacy increases as more access to funds become assessable. Therefore, strong economics will make education available to all the people.

- ***Enhancement of the healthcare system***

  A significant percentage of the developing world population, particularly in rural areas, has virtually no access to a meaningful healthcare program. Poor infrastructure, inadequate transportation and low level of education are facts in developing countries. Strong economy is necessary to enhance the health care of the country. It plays a significant role in improving the infrastructure, in terms of financing the special needs of the population.

- ***Reduction of crime rate.***

  Poverty was the first sociological variable ever looked into as a possible cause of crime. There are two reasons why poverty came to be of interest: (1) it was an enduring social problem in all societies across time and (2) it was suspected that certain variables in the causes of poverty were equivalent as the causes of crime. Bad economy is the element that increases the crime level in the country. Developing a strong economy will aid the country to reduce crimes.

Engineering management is necessary and crucial in order to improve the economies of developing countries; it will improve all related issues that have been mentioned previously. The importance of engineering management in economics is that it becomes the catalyst created by combining both technical and managerial skills in industry. Engineers are very knowledgeable, efficient and productive when it comes to product design, manufacturing process, quality control and maintenance and capital machinery installation issues. In addition, when it comes to personnel and human resource management, interest factors, cost benefit analysis, comparison of alternatives, sensitivity

analysis and inflation, income taxes, depreciation, replacement cost analysis and risk and uncertainty in decision making, engineers are even better because of their technical background supporting their management skills. In industries, engineers and engineering management are significant keys in order to succeed. Bad manufacturing may mean bad engineers and bad engineering management administration. Mostly, in developing countries bad industries exist. Therefore, engineering management is important due the contribution of industry and the economics of the respective countries. Below, a few in-depth descriptions are provided to illustrate progressive management.

1. Strategic Engineering Economic Decisions:

The rational decision-making process is an essential role that engineering management plays in economics. Engineers are called upon to participate in a variety of decision making processes such as manufacturing, marketing, and financial decisions. In developing countries, the decision making process is important in terms of assessing the needs of external criteria such as those of its population and environment. In manufacturing, engineers are involved in decision-making processes in every detail of a product's production, from the conceptual design to shipping. Engineering decision making accounts for the majority of product cost. Consideration for capital assets such as building, labors, and machinery allows the engineer to have greater understanding of process synthesis. Engineers contribute a crucial role in the effective utilization of corporate financial assets as well as precise analysis on product demands. Maximization of the economic benefits of the understated objectives in production must account for some acceptable risk.

Engineers with the concept of engineering management typically initiates from absolute undefined parameters to well designed products. For instance, when a new idea is introduced, the engineer designs the required processes to establish the governing procedures for screening the ideas and projects. Once the project ideas are identified, engineers typically classify them as five types:

1- Equipment and process selection

2- Equipment replacement

3- New product and product expansion

4- Cost reduction

5- Service or quality improvement.

This classification scheme facilitates management to address key questions: Can our project achieve the new production levels? Does the firm have the knowledge and the skills to undertake this new investment? Engineers are well prepared to answer these questions and help the firm screen out proposals that are feasible given a company's resources. Provided below, we illustrated the underlying concepts:

Selecting equipment is an example of rational decision making presented by engineers throughout industry. The decision making process involves selecting the best source of action, when there are several methods that are considered to meet a project's requirements. There are various situations to be considered: Which of several proposed items of equipment shall we purchase for a given purpose? Which equipment will be more productive? Which one will reduce the capital cost of the product? These are questions faced by the engineer in industry. On several occasions, the decision involves considerations of the expenses necessary to replace worn-out or obsolete equipment.
In investments, engineers may face two common types of expansion decision situations. The first category includes decisions about expenditures to increase the output of existing production or distribution facilities. The second type of a decision making analysis includes the consideration of cost necessary to execute various designing contentions that may or may not be applicable due to geographical location and provided resources. In both cases, engineers have the ability to analyze and project. A cost reduction project is one that attempts to lower the firm's operating costs. Engineers have the ability to analyze the project and find ways to reduce the cost. The facet of an economic decision of popular interest from an engineer's point of view is the evaluation of costs and benefits associated with making a capital investment. In summary, engineering costs reflect the following factors:

1. Design and development cost
2. Material content
3. Outsourced components
4. Labor content
5. Accommodation (rent, lease of building and land)

6. Business operation costs (administration, finance costs)
7. Marketing and distribution costs
8. Product service and maintenance costs
9. Environment costs (safe disposal, recycling)

2- Engineering Management in Predicting the Future:

In considering engineering economic decisions, the measurement of an attractive investment plays a crucial role in production initiations. However, information required in such evaluations always involves predicting of forecasting product sales, product sell price, and various costs cover some future time frame. Predicting the future in engineering management is characterized by five main issues: technology, process orientation, products, and political issues.

1. Technology:

Changes in technology are a main challenge engineering managers have to face in industry. It has been changed extremely rapid throughout the past twenty years (Figure 1). Engineers have the ability to predict the future of the technology.

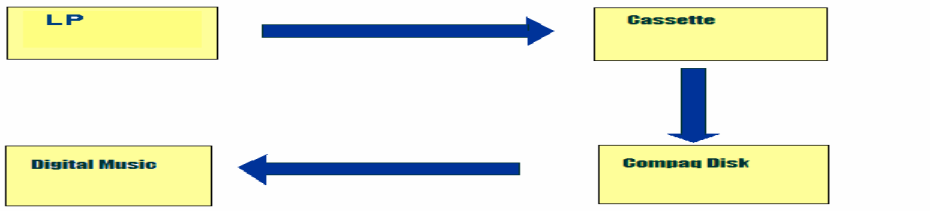

Figure 2 shows the rapid change in music instruments in the past 30 years

Forecasting methods are used to predict developments in the areas of economics, sociological, and demographic change and hence to forecast changes in technology. Technological forecasting methodology is classified as follow:

-Persistence: this method assumes that what is happening now will not be totally changed. It means that the technology is improving on a fixed track. The future will be like the past with only some changes. Cars are an example of this type of technology; changes

are happened in different areas in cars like adding new options or changing the used materials; there will be no big change in this technology.

-Trend Analysis: this method assumes that the future technology is partially dependable on the past performance. The trend concept consists of analyzing the past and then expending into the future assuming continuity. This method also involves some graphical and mathematical techniques with extrapolation such as: linear regression, nonlinear regression, multiple linear regression and exponential smoothing. Trend analysis techniques are well used for the short to medium term (up to two years).

-Cyclic: this method is used to identify and explain any cyclic regularity in the series such as seasonal series. It is based on present data that are assumed to be cyclic in nature. Various time-series analyses and techniques used in this type of forecast.

-Associative: this method used when there are plenty of factors involved in changes in technology such as changes in performance, cost, or usage of other materials. It is also useful to show a relationship between changes in one technology to another. This method uses trend extrapolation, scaling graphs, and correlation techniques.

-Normative Forecasting: this method assumes that the technology will materialize to fill needs. This means that normative forecasting method is directed toward the discovery and evaluation of future needs, and toward the importance of this technology for the future needs. This method examines the relationship between the future needs and the future of the technology. It uses some techniques including morphological analysis, and social technological plans

2. Process Orientation:

Process orientation is another challenge for engineers. First, engineers have to well understand the process and experience its advantages and disadvantages; they have to define the strength and weakness of the process as well. Engineers must understand their processes so that they can demand more accurate supportive implementations for them.

Questions are addressed by engineers in order to predict the future of the process may include some of the following:

-What are the parameters, variables, inputs, and outputs of this process?

-What is the weakness of this process?

-Where should the process be improved in this process? Which part? Which area?

-How should I reduce the time of this process?

-Have there any improvement happened recently from outside?

-What are the competitors doing? What are their demands?

Answering these questions may serve as a guide for the engineer to forecast the future of the process. This requires a detailed definition of the process, an understanding of how much control will be enforced, surveillance of how well the process is followed and where other improvements can be made. Better understanding and implementations of processes enables improved support for users in assessment for a product of high quality.

3. Products:

Predicting the future of products has two dimensions; these include improving the products, and predicting a new line of product. Improving the product is an important issue engineers have to deal with in industry. Engineers have to analyze and criticize their products and their advantages and disadvantages and find ways to improve their products Furthermore, engineers face new productivity challenges that require optimized performance to maintain a competitive advantage. In today's global marketplace, with inexpensive personnel resources, efficient distributed manufacturing and distribution, and aggressive margin-depleting pricing, development groups are required to produce differentiated products more efficiently and more effectively. To survive in this environment, engineers may use production-oriented computational tools for materials research that allow for comprehensive product development pipelines that extend through rational design, identification, characterization, and manufacturing.

Predicting a new line of product is another important challenge for engineers. This may be similar with predicting technology; however, predicting a new line of product requires more efforts in terms of analyzing the customers' needs and demands. Engineers

have to understand their customers in order to suit their particle needs and hence to increase profitability.

4- Political Issues:

The politics of a country is a critical issue that affects the economy and industry, especially in developing countries where politics is unstable. This means that not only the politics is unstable, but also the rules and laws the government introduces are also unsteady. For example, when the new government in Syria introduced some new economic laws, a few months later they had to make changes to better fit the needs of the population which led to amendments and installation of revised laws... This situation affected the manufacturers and their future, predicting strategies. Therefore, the engineer also has the responsibility of assessing the future trends of political issues.

Conclusion:

In recent years, economic activity has increased globally. Globalization offers the potential to raise economic growth rates significantly, but at the same time it exposes firms and economies to immense competitive pressure. Developing countries are particularly exposed to those pressures. There great differences between developed and developing countries due to the quality of engineers and engineering management.

Engineers in developed countries are very knowledgeable, efficient and productive when it comes to product design, manufacturing process, quality control and capital machinery installation issues. In addition, they have high manageable skills; they apply very well the valuable characteristics of engineering management. In developing countries, on the other hand, engineers have relatively low professional skills, lack of communication skills, and little knowledge of modern materials and organizational methods. The result is low productivity and performance levels for infrastructure and services that rely on engineering such as: construction, energy supplies, transport, manufacturing and process industries.

The costs of these investments or services are often higher in developing countries, this results in an inefficient economy. High cost, low productivity and performance in these services is also related to the quality of engineering management in developing

countries. Engineers in developing countries must utilize the engineering management principles; planning, organizing, staffing, controlling, and leading. Engineering management in industry must be applied to enhance engineering services and economical issues. Furthermore, engineers in developing countries must participate in a variety of decision making processes. In developing countries, the decision making process is important in terms of assessing needs.

In addition, engineers are involved in many other external forces in terms of engineering management. As mentioned previously, such external forces may include involvement in understanding the specifics of the available technology for product synthesis. They also have to predict the various methods in processes that they can attribute to the efficiencies of their product designs. Another more important aspect of the industry that they must have a working knowledge of is their grasp of the politics that governs the economics of their industry. These preliminary concepts are all vital in the deduction of a low quality infrastructure within these developing nations. As a direct result, the correlation of engineering management will infuse a critical role on the improvements of the country's economics. A strong economy will increase the capital national income, quality of life, social stability, education, healthcare system, and contribute to a reduction in crime rates.

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