

## **ROLE OF ENGINEERS IN ECONOMIC DEVELOPMENT AND POLICY FORMULATION**

By

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### **Introduction**

What is the role of engineers [1] in the society?

- Engineers vitally contribute towards global challenges with their hard work and innovations
- Engineering projects involves a complex set of decisions making process – design; the success of which is measured in success of the project.
- Engineering education empowers its students with powerful analytical tools like cost benefit analyses, detailed economic and financial analyses in addition to other analyses and design tools for engineering judgment.

It is unfortunate reality that the governments do not recognize or consult professional engineers before making critical decisions. On the other hand professions like Legal and medical are consulted whenever government legislature is put in place. In general, the public do neither appreciate nor understand their contribution towards the development of society.

Major process of decision making is left with non-engineering professions like politicians, managers, lawyers, accountants and marketing experts.

The risk of poor decisions unfortunately increases when governments do not recognize the need for technical expertise. Environmental and Social consequences are also gaining importance to make decisions 'green' in the long run. Demand for projects in this respect is getting more complex needing expertise in a wide range of fields in addition to the Engineering.

### **Definition of an Engineer**

*'An engineer is someone who solves problems (efficiently and effectively) to maximize benefits.'*[1].

There are more than 24 main branches of engineering and many more secondary branches.

Previously, engineers use to solve problems (efficiently) to maximize benefits by directing the great forces of nature for the benefits of mankind.

Nowadays, the challenge for Engineers is even greater as he is expected to solve multidimensional problems and minimizing the use of natural resources; thus preserving the environment and requiring multidisciplinary teams i.e. breaking the problem into different components and solving it with traditional skills.

### *New Challenge*

*Minimization of use of natural resources*

*Safety of Environment*

*As wide as possible benefits*

This paper discusses the economic growth of Pakistan with an aim to highlight the contributions of the engineering community as a whole and identify their role in planning and development and the future challenges to this contribution for a sustainable economic growth.

Engineers form a major technical force in our society who is being trained to carry out a wide variety of tasks, starting from planning and designing to execution and maintenance of large projects in all walks of life. They are employed in government sector, private sector, public companies, large to medium industry. Some of them have become major entrepreneurs directly contributing to the economy of the country.

In Pakistan, like any other country their role is to contribute in the development of the country to achieve sustainable growth in economy. Due to limited opportunities within the country, a large number is working outside the country mostly in the Middle East and their remittances contributing to the economy in the form of much needed foreign exchange.

In the public sector large institutions formed to serve different requirements are created by the government like Irrigation and Power Department, WAPDA, Public Health Department, Highway department, NEPRA, etc. at national and provincial levels. The organizations employ engineers as their main technical force under one roof to serve the nation. Planning commission at national level and P&D departments at provincial levels employ engineers for planning and implementation of projects necessary for economic development of the country.

Detailed future planning for economic development of the country is carried out at national level by the Planning Commission of Government of Pakistan in a regular development initiative under 5-year development plan which was showing way ahead to a young nation. The plan was developed and followed by the government at a regular basis. Most of the members planning commission are engineers from various disciplines. After 2004, the 5 year plan was renamed as medium term plan and long term plan on 25 year bases was introduced.

Engineering community is tied together at different forums for sharing their experience like Engineering Congress, Pakistan Engineering Council and Institute of Engineers. These organizations have a major role to play in organizing the community to work for the development of economy of the country.

### **Historic Perspective of Economic Development in Pakistan**

Pakistan's political economy is one of the most difficult to understand. A complex set of competing and overlapping clans, sectors, beliefs, and practices defies any easy description and analyses [2].

Development history of Pakistan can be broadly divided into three well defined eras like

1. From independence in 1947 to 1971 when Pakistan was a bigger country East and West Pakistan
2. From 1971 to 1982 when Russia entered Afghanistan
3. Post Afghan war i.e. the current situation

Role of engineers in economic development has changed gradually from an effective role to gradually diminishing role. This may be due to changing priorities of different governments.

Most of the large development projects like Mangla, Tarbela dams, and some of the barrages were conceived as a part of Indus water treaty. Major Infrastructure development took place like Road transport network, railway network and airports provided the necessary transportation facilities for development of natural resources. Also projects like, steel mills, atomic reactors for power generation, cement and fertilizer factories were conceived and constructed during the first era.

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Engineering Organizations like WAPDA, NESPAK were created to cater for the development needs. These organizations in addition to the government departments provided the necessary platform for the engineers to work at all levels inside the government and the private sector. During this period, the private sector took the initiative and resulted in rapid industrial growth and Pakistan's Economic growth was quoted as an example in the international arena.

During the post 1971 era, the economic growth of the country lost its direction with the government decision to nationalize of major industry and educational institutions. This resulted in a major setback in the rapid growth of the country. However, the engineering sector continued its momentum through major projects in the government sector like Tarbela dam, Nuclear power projects with a major leap in developing nuclear capability to counter India's initiative to develop a nuclear weapon. This initiative continued through the 2<sup>nd</sup> and 3<sup>rd</sup> eras due to presence of military tension with India for a major duration; a success was achieved by the engineers with indigenous developments in the field of nuclear engineering and Pakistan achieved a major breakthrough in enrichment of Uranium.

The government planned to construct Kalabagh dam to further develop the agricultural sector in early eighties. The project was a major source of energy and water necessary for a sustained agricultural growth. Its operational studies along with the Tarbela reservoir showed major improvements in overall water and energy supplies to the national grid even during low flows of winter months. The project was politicized at national level by politicians and their non-technical supporters without giving weight age to the tremendous benefits being wasted and its construction was postponed till to-date in the name of national consensus.

Gradually the military development took priority and all the national development plans slowed down without providing alternative route to economic growth and development. Although the economic growth continued at a slower pace without direction, a major boost in Agricultural sector and subsequent initiative of the government in the textile sector made the economy of the country to continue its journey through difficult times; the oil prices sharply increased and a major setback in the form of shortages in electricity supplies affected the industrial growth and the overall life of the country pushing masses to continued darkness resorting to severe load shedding. The continued population growth of more than 2% per annum also took its toll with limited growth and inflationary pressures started pinching the common man.

The political instability and limited national economic growth resulted in pushing the masses to below poverty line (around 40% of the population). The shortages of energy and hike in international oil prices resulted in limited industrial growth and high cost of living pushing the country into further debt ridden economy.

One major wrong decision at national level was postponement of Kalabagh Dam construction has pushed the bright future of the country into darkness of at least 30 years duration. It is not only that we are short of power, we have ended up buying a very expansive power from the privately owned companies importing fossil fuels at exorbitant prices throwing a major part of hard earned foreign exchange to the payments for procurement of fuel for the power plants.

Due to poor implementation of resources and limited funding during the last 20 years, we have lost direction and ended into a reverse gear on all walks of life.

### **Major Achievements**

Not everything went wrong / negative, definitely there were few positive developments during this period. Major improvements can be seen in the road network of the country again a contribution of the engineering sector. Power production in the private sector showed a tremendous growth although not keeping pace with demand growth. Hydropower development for other projects was reinitiated which became stagnant for a long time due to consensus could not reach over construction of Kalabagh Dam.

Development on the atomic energy utilization increased with the help of Chinese reactors and indigenous fuel reprocessing technology acquired by the country.

Nuclear capability lead to acquisition of atomic bomb, missile technology and its launching capability and Pakistan emerged as the 7<sup>th</sup> most powerful nation on the face of the earth equipped with nuclear capability.

Figure 1 shows the growth in GDP, from 1952 onwards the bar chart shows a wide variation of growth rate starting from a negative value, and figures vary from 0.88% in to 10.2% in 1952. The average is around 5.5% which is commendable {1}.

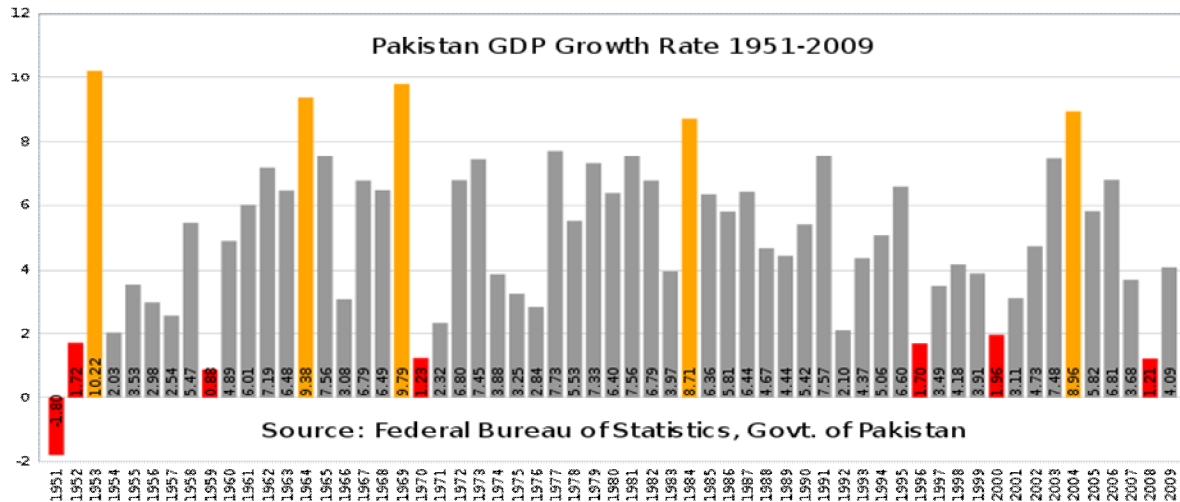
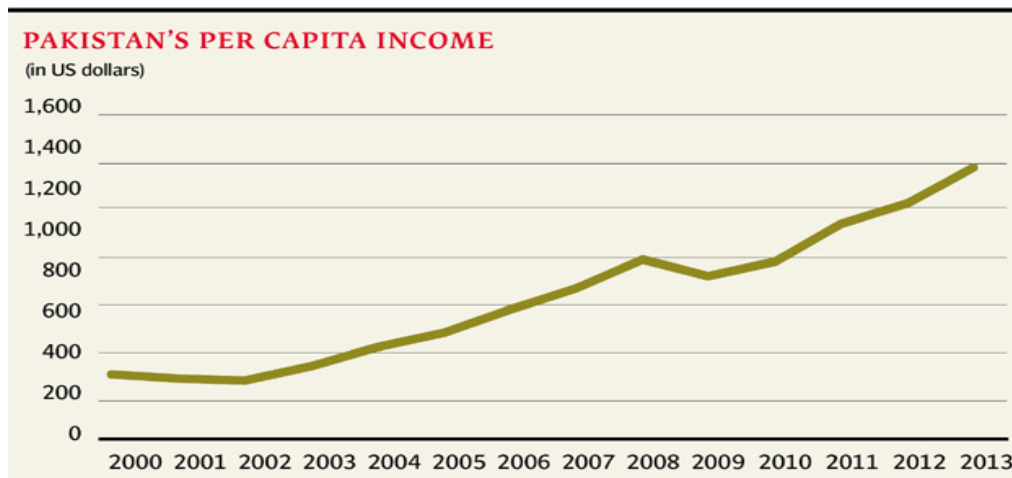


Figure2 shows the growth in per capita income growth rate from year 2000 to date. It appears slightly optimistic touching \$1400 in 2013 [1].



**Infrastructure Development**

*Big infrastructural Schemes are vital for Nations growth.*

A large number of major infrastructure projects were executed during the last 66 years history of the country. These include highways and motorways along with farm to market roads. Being an agricultural based economy, major developments of infrastructure were planned and executed in the irrigation sector like Barrages, irrigation canals, storage dams, etc.

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Two major sea ports i.e. Port Qasim and Gwader port were constructed in addition to Karachi that already existed at the time independence. To provide air link between major cities, airports were constructed and air routes were defined to provide rapid movement of passengers from one part of the country to another.

Vast rural areas were supplied with electricity through the national grid as a part of the infrastructure development. Major initiatives were required to keep up with the population growth in the power sector. Initial power supply for the country was supplied by the two major dam projects i.e. Tarbela and Mangla and Ghazi Barotha Projects. As a secondary supply especially during winters when hydropower production becomes very low, a number of fuel based power projects like Guddu, in public and private sector like KotAddu, Lalpir, etc. were installed to feed the national grid.

Large industrial units were installed to produce chemicals and fertilizer to meet the national demand of industry and agriculture like Fauji fertilizer, Engro chemicals, etc.

To support the industrial growth, the steel mills project was launched with the help of Russia. With this initiative a major development took place in the downstream steel industry. This was further ignited by allowing automobile spare parts being produced in the private sector.



**Figure 3 Highway network of Pakistan [1]**

Figure 3 shows that the whole country is now connected through a vast road network with blue lines are showing express ways and green color for motorways.

### **Contribution of Agriculture Sector**

Pakistan is one of the world's largest producers of the following commodities according to FAOSTAT, the statistical arm of the Food and Agriculture Organization of The United Nations, given here with the 2008 ranking:

Apricot (3rd)  
Buffalo Milk (2nd)  
Chickpea (3rd)  
Cotton, lint (4th)  
Cotton, Seed (3rd)  
Dates (5th)  
Mango (6th)  
Onion, dry (4th)  
Oranges (11th)  
Rice, paddy (11th)  
Sugarcane (5th)  
Tangerines, mandarin orange, clementine (9th)  
Wheat (10th)

Pakistan's principal natural resources are arable land and water. About 25% of Pakistan's total land area is under cultivation and is watered by one of the largest irrigation systems in the world. Pakistan irrigates three times more acres than Russia. Pakistan agriculture also benefits from year round warmth. Agriculture accounts for about 23% of GDP and employs about 44% of the labor force.

### **Industrial Growth**

Industrial Sector contributes about 24% of the GDP with a growth rate of 6% per annum. Major industries are textiles, fertilizers, chemical and pharmaceuticals, oil refineries, dairy products, automobiles, food processing, construction materials, cements, beverages, clothing, paper products. Textiles based on cotton goods are major contributors in exports and foreign exchange earnings. Power shortages have resulted in limited further growth of the industry. Many industries have now switched to their own power plants to solve the problem.

### **Service Industry**

Major improvements took place in the services sector in the country. With the advent of mobile technology and internet, a large chunk of money is being invested in this sector. Pakistan has a very growth rate in these services and following very closely with the international developments.

**IT Software** development for computers and mobile technology has given a major boost to job openings locally as well as internationally. Demand for education in these sectors is also growing resulting in large number of institutes giving degrees in the IT sector. Also new software development companies are utilizing the resources for software developments and exports are growing fast in this sector.

**Telecom:** Four major telecom operators have established their network in the country covering the whole country providing telecommunication services to far flung areas. They provide very cheap and

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reliable service of data transfer and telephonic services to their customers. These operators are a major source of tax revenue to the national exchequer.

**Banking:** With the growth of the telecom sector, the modern banking services have grown substantially. All the banks are modernizing their branches for mechanized banking and providing services to remote customers through the internet.

### **Science and Technology**

To develop the science and technology in the country, major initiatives were taken to train manpower from internationally recognized institutions in the form of scholarships to deserving candidates in the field of engineering and science by government and donor agencies like US aide and British council. Post graduate research and development was initiated through PCSIR, PINSTECH, Centre of Excellences in a number of engineering fields and many post graduate research institutes in the local universities.

Due to insufficient planning and limitations of funds in government sector slow and dull environment prevails in the local institutes, due to this major brain drain is taking place and most of the qualified scholars are leaving the country for better opportunities.

Recent initiatives in the field of alternative energy sources like solar, wind and waste management are well on their way to solve the energy shortages in the country at a local level.

However, major contributions were made by internationally recognized scientist and engineers for the development of science and technology. Names like the following may be recognized as heroes of the nation due to their contributions in the field of science and technology;

- Professor Dr. Abdus Salam
- Dr. Salim uz Aman Siddiqui
- Dr. Qadeer Khan
- Mazhar Mahmood Qureshi
- Munir Ahmed Khan
- Dr. Atta ur Rehman

Major improvements are taking place in the education sector to cater for the demands in the new fields like medical science, software and hardware engineering, telecom engineering, etc. A large number of institutes in the government and private sector are being established to impart education in these areas.

Unfortunately, Pakistan could not keep pace with the technological development especially electronics and computers that has brought major improvements in every walk of life. Technology transfer from developed world has been negligible mainly due to poor planning and limited skilled labor availability in the country.

This handicap has forced the country to remain dependent on imports of all kinds of goods and spare parts for the industry.

### **Future Scenario**

The world under future scenario is turned into a village with tough competition in trading and exports. With the recent developments in China, the mass production of most of the industry has been shifted to

china from all over the world. This mainly due cheap and skilled labor provided by the Chinese. This has tilted the volume of exports from china to other countries tremendously.

The survival of local industry in Pakistan is getting difficult day by day and most of the manufacturing units are getting uneconomical to run and maintain. Thus the local industry is closing down and businesses are shifting towards trading from manufacturing.

This requires a major change in trading strategy to cut down the trade deficit.

In order to be competitive in the international market we need to sort out the following challenges to enhance our exports and improve overall our image. Engineers have to contribute further and change their role and more innovative for solving the problems of the industry and also for the people of Pakistan.

### **Major Challenges**

Overcome Power Shortages

Cost cutting at every level

Education of Masses

Production of Skilled labor for Hitec industry

Overcome terrorism

Stop brain drain

The innovation will come from the learning and use of new techniques and materials especially the acquisition of computer technology. Computers have now entered into every walk of life. Learning their use is important, however, the production of computers according to our requirements. Material science is an area where we lack the most. Nearly all the products and gadgets require specific materials to work with. Producing those materials for our own use is the key to success.

A similar initiative is required as in the case of uranium enrichment was taken by the GOP. The support from the government and involvement of the resource from the private sector are necessary to bring that change.

### **Conclusions**

Engineering is a precise science requiring facts and figures very similar to running a business. The training helps in value judgment based on facts and figures avoiding unnecessary speculation and emotional judgment over rational decision making [3].

Definition of an engineer is someone who is "Directing the great forces of the nature for the benefits of the mankind". The above discussion shows that engineers are prime contributors in the economic development of the country.

However, the earlier role must change from a simpler one to more innovative and demanding role by using computer technology for cost cutting through new and powerful techniques.

This is only possible if our education sector can be transformed into a state of the art system where innovative ideas in design and new inventions could be generated for cost cutting in industrial



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development. New ideas in product design is the way to success. A recent example is the smart phone ideas of Samsung simply out performed all the major competitors of the world using innovative ideas.

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