IEP-SAC JOURNAL

2020-21

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Trends and Future Directions

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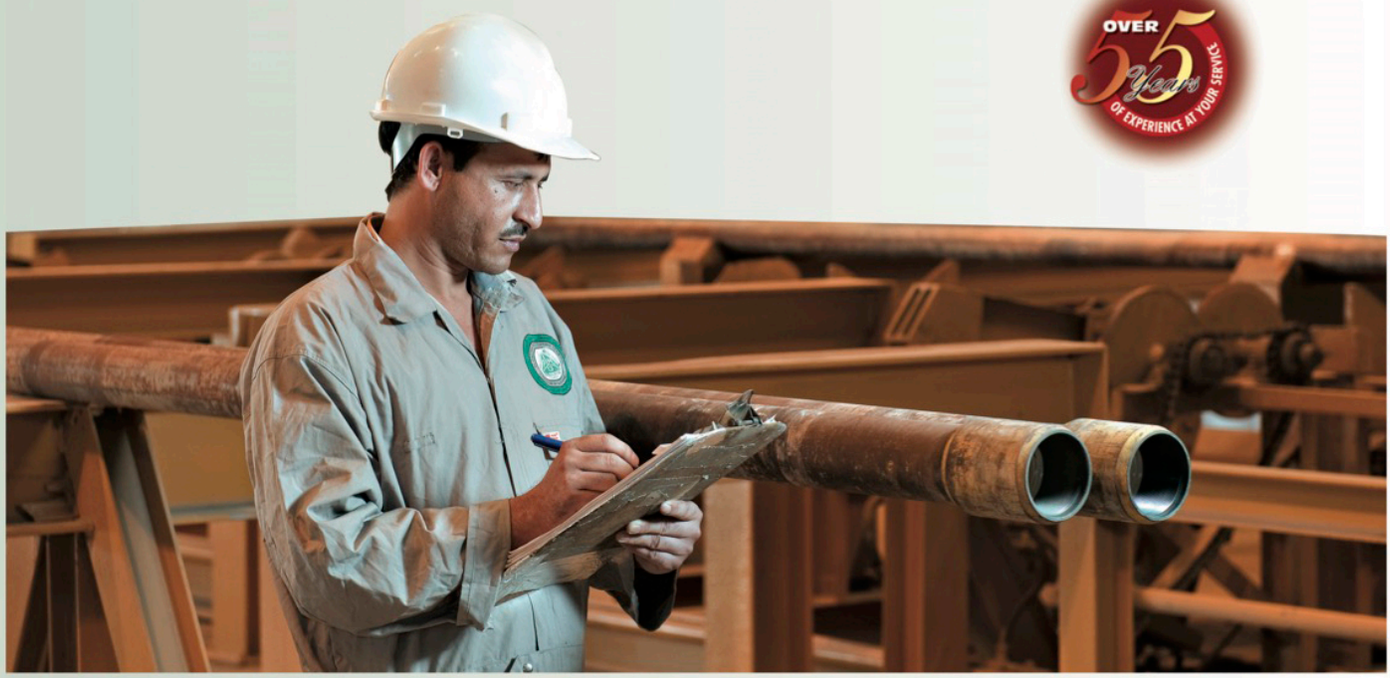

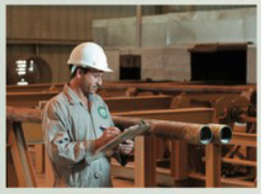

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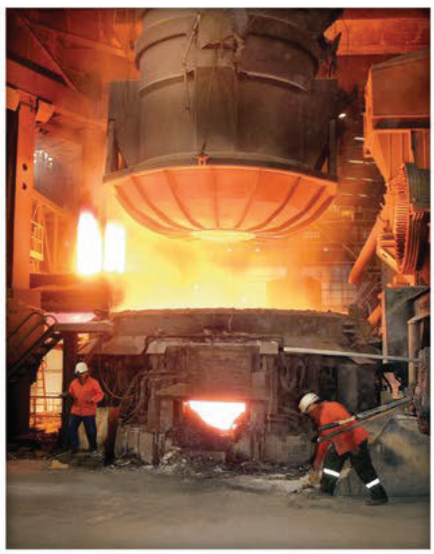


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IEP-SAC Journal is published yearly by the Institution of Engineers Pakistan, Saudi Arabian Center (IEP-SAC), Riyadh, and distributed to the engineering community in Saudi Arabia. To promote discussion of issues in the field of engineering and ensure coverage of all responsible points of view, conflicting opinions and views may appear, however, IEP-SAC cannot accept any liability for such views nor for any errors or omissions.

Designed By:
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MAKE 2021 YOUR YEAR OF SUCCESS

Message from Chairman IEP-SAC

2020 has been a year unlike any past year. The global pandemic led to major changes in the operation of all kinds of businesses throughout the world, which had a great impact on the engineering industry in ways no one could have predicted. But challenges always create opportunity. It's time to make 2021 your year of success.

Al-Hamdolillah, before start of Covid-19 in KSA, we organized all our seminars and picnic as usual; however the annual seminar planned in April, 2020 could not be executed due to lock down situation. Although by the grace of Allah SWT we managed to organize two seminars during mid of our 2019-20 session; one in November and the other in December, 2019. Even during the difficult time of pandemic we managed to organize a mid-term on-line seminar in September, 2020 on the topic "University-Industry Liaison and Pakistani Diaspora" delivered by Prof. Dr. Sarosh Hashmat Lodhi, V.C. NEDUET, Karachi.

It is well known and proven fact that a large portion of the economic growth of any nation is the result of knowledge intensive activities which involve academic and systematic research on issues and problems faced by the industry. In developed nations the systematic research was introduced in the society by gradual legislation. From this forum I would like to raise the voice of all Pakistani engineers in KSA to our government to make appropriate legislation, so that a knowledge sharing relationship between academia and industry could be developed. We always insist on the quality and standardization of the education; since collapse of education system is the collapse of nation.

In the annual seminar on 15th January, 2021, we are going to present our new IEP-SAC digital journal for the year 2020-21. Sustaining our legacy from past several years, this journal includes messages from various organizations and personalities, numerous technical papers, annual report by the GS, Eastern region sub-centre report, scholarship committee report, pictures of various events in Central and Eastern regions and the famous directory of Pakistani Engineers in KSA with recent updates.

The Institution of Engineers Pakistan – Saudi Arabian Centre (IEP-SAC) is providing a platform to all Pakistani engineers in KSA to excel their skills, share knowledge through seminars and technical papers, socialize among engineers along with their families, and help needy / meritorious engineering students in Pakistan; all done under the patronization of Pakistani Embassy.

On behalf of IEP-SAC, I would like to express the gratitude to the Custodian of the Two Holy Mosques, King Salman bin Abdul Aziz Al-Saud, Crown prince HRH Muhammad bin Salman bin Abdul Aziz and the Government of the Kingdom of Saudi Arabia for their hospitality and cooperation to Pakistani community and engineers in KSA. We are grateful to H.E. the Ambassador of Islamic Republic of Pakistan and embassy staff for their unceasing support and patronage to IEP-SAC. I extend my accolade to all of our council members in Central and Eastern regions for their dedication and commitment towards the IEP-SAC goals and objectives.

We shall exert our utmost efforts to come up to the expectations of our beloved father of nation Quaid-e-Azam Mohammad Ali Jinnah, which he mentioned at the time of inaugural of IEP in 1948 that we shall not only benefit the engineers themselves by improving their technical knowledge but also bring lasting benefits to public services which they are called upon to perform.

Finally, I would like deliver a message in the form of a hadith which has been narrated by Abu Huraira (May Allah be pleased with him. The Messenger of Allah, peace and blessings be upon him, said, "The wise saying (i.e. Knowledge or حکمت) is the lost property of the believer, so wherever he finds it then he has a right to get it." So, it is our duty to find the knowledge and get it with high excellence.

Best regards and good wishes for all

(Engr. Syed Muhammad Iqbal Ahmed)
Chairman, IEP-SAC, KSA
Friday 15th January, 2021G

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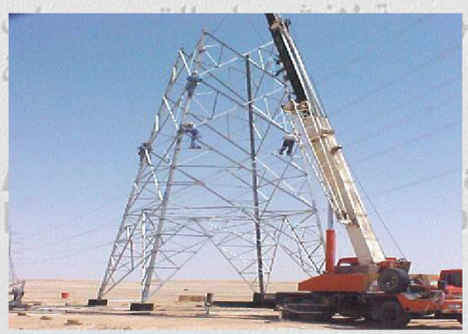

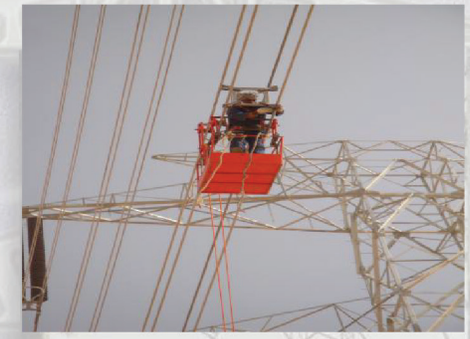

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From The
Ambassador of Pakistan

No.Amb-1/2021 11 January 2021

I am pleased to note that the Institution of Engineers of Pakistan-Saudi Arabia Chapter (IEP-SAC) publishes an informative magazine every year. I am hopeful that like past, the Journal for the year 2020-21, would also provide useful and upto-date information in the relevant fields to the Pakistani Engineers, Architects and Town Planners working in the Kingdom of Saudi Arabia.

It is encouraging that Engineers from Pakistan have played a significant role in the development of the Kingdom. They are also playing a constructive role in promoting the soft image of Pakistan through their hard work, professionalism and commitment. I am confident that in future the Pakistani Engineers will continue to discharge their duties professionally. Pakistani Engineers have also contributed in strengthening the friendship between Pakistan and Saudi Arabia.

I am happy to learn about the social and philanthropic activities being undertaken by the Pakistani Engineers. I appreciate the efforts of IEP-SAC for providing scholarships to deserving students studying in various engineering colleges and universities in Pakistan.

I extend my best wishes to IEP-SAC and Pakistani Engineers for more success in their future endeavors. I assure them of full support of the Embassy in their activities towards promoting goodwill for Pakistan in the Kingdom and their contributions towards the development of Saudi Arabia.

Raja Ali Ejaz
Ambassador
of the Islamic Republic of Pakistan
Kingdom of Saudi Arabia

MESSAGE FROM THE PRESIDENT OF
THE INSTITUTION OF ENGINEERS PAKISTAN

It gives me immense pleasure to know that the Institution of Engineers Pakistan (IEP), Saudi Arabia Centre (IEP-SAC) is holding 55th Annual Technical Seminar on 15th January 2021 and bringing out its annual publication, "The IEP-SAC Journal", on the occasion.

On behalf of the Institution of Engineers Pakistan (IEP), I avail this opportunity to congratulate IEP–SAC for its continued and consistent efforts in making positive head way in pursuit of its enormous goals by providing unlimited opportunities, incentives, professional recognition and leadership potential. Your scholarship program for the needy students in Public Sector Engineering Universities in Pakistan and Azad Kashmir deserves all praise.

Publication of IEP-SAC Journal containing important Articles on current engineering issues and holding Technical Seminars always help to exchange knowledge and information for the best use of engineering profession and building professional ties among the professional engineers of different nationalities, thus building positive image of our country. We are proud of this achievement of IEP-SAC and wish for its great success in coming events and assure full support and acknowledgement on behalf of IEP.

Engr. Dr. Javed Younas Uppal

President, The Institution of Engineers, Pakistan

MESSAGE FROM THE SECRETARY GENERAL OF THE INSTITUTION OF ENGINEERS PAKISTAN

I am pleased to learn that the Institution of Engineers, Pakistan (IEP) Saudi Arabia Centre (IEP-SAC) is organizing its 55th Annual Seminar on 15th January 2021 and publishing its annual magazine on this occasion.

Holding of technical Seminars and Publishing the technical Journals play an important role in sharing the technical knowledge and expertise among the fellow Engineers and are a great Contribution in disseminating the technical knowledge.

The efforts of Institution of Engineers Pakistan Saudi Arabia Center (IEP-SAC) in this regard are commendable and deserve highest appreciation. The seminar will definitely help in advancement of Engineering Knowledge and welfare of Engineering Community working in Saudi Arabia.

I pray for the success and useful outcome of the event.

Engr. Amir Zamir Ahmed Khan

Secretary General, The Institution of Engineers, Pakistan

Annual Report by General Secretary

The year 2020 is now gone, but it has left quite many scars and unanswerable queries. Some see this year as a redemption for humanity, and others see it as a precursor to the greater challenges we are yet to face. Whatever the case maybe, this year opened up many new tangents for us to ponder. After all the advancements in Science and Technology, we saw the social fabric torn apart by a virus. The enormity of the challenge showed us the vulnerabilities of our societies and the lifestyles we follow. This year forever changed the lives of millions of us; the families who lost their dear ones during this pandemic.

This is just one side of the story. The other side is the way people responded to this pandemic. The authorities implemented the restrictions and the masses adopted the new rules and modes of operations instantly. Never has any vaccine been released in such a short time, and that also in enormous quantities. The tech companies quickly adopted their infrastructure to the sudden surge for internet bandwidth, users' connectivity and processing powers for services availability. Businesses embraced the situation and adopted remote working modes. When the paradigm shifted for established businesses, new business venues were also quickly explored and adopted.

Institution of Engineers Pakistan Saudi Arabian Chapter (IEPSAC) was not an exception during this situation. The organization also adopted the changed realities and introduced online meetings and seminars. Never had IEPSAC conducted any online technical seminar before. This year several technical seminars were conducted in Central and Eastern regions which were appreciated by the community. The details of IEPSAC events since the previous publication of the annual journal in May 2019 is as follows:

IEPSAC Annual Seminar 2019

The annual seminar was arranged on Thurs Apr 11, 2019 at King Salman Social Center. The topic of the seminar was "PAKISTAN WATER SECURITY INFRASTRUCTURE – ROLE OF ENGINEERING PROFESSION" delivered by Prof. Shahbaz Khan, Director Regional Science Bureau for Asia and the Pacific and UNESCO Representative for multiple Asian countries and the Research Director for Irrigation system in Australia. The Chief Guest at the occasion was the Welfare Attaché at the Embassy of Pakistan in Saudi Arabia, Mr. Abdul Shakoor Shaikh.

In his presentation, Professor Khan said that Pakistan could become from "Water deficit" to "Water Secure" country by adopting the research based globally accepted methods. The systematic approach to achieve this objective in the next 10-12 years should focus to have sufficient and reliable water supplies, healthy and resilient rivers and productive water agriculture. He advised the engineering community to lead the awareness campaign of water

challenges and present the workable solutions to the decision and policy powerhouses in the country. The session was followed by the question and answer session which was conducted by Dr. Rafiq Choudhry.

The chief guest, Mr. Abdul Shakoor Sheikh said that Pakistani engineers are playing a vital role in the development of the brotherly country of Saudi Arabia. He praised the expertise and hard work of the learned guest speaker to present the water crisis of Pakistan and suggesting workable solutions. The Chairman of IEPSAC, Engr. Syed Muhammad Iqbal praised the guest speaker for traveling all the way from Jakarta to deliver the scholarly and informative lecture on the subject.

Shields were presented to the advertisers and sponsors of IEPSAC in recognition of their support for the organization. Certificates of appreciation were also presented to the authors of research papers published in IEPSAC annual journal 2019. The IEPSAC 2019 annual journal and a souvenir gift were distributed among the participants and the event concluded with the dinner.

IEPSAC Mid-Term Seminar

To raise the awareness on the global issue of Environmental Pollution, IEPSAC arranged a technical seminar on Friday, 22nd of Nov. 2019 on the topic "Environmental Pollution: Causes, Effects and Control with Emphasis on Islamic Perspective" delivered by Engr. Syed Mubashir Hussain Kirmani. The chief guest at the occasion was the Welfare counselor of the Embassy of Pakistan, Mr. Mahmoud Lateef.

The Engr. Kirmani, a Civil Engineer having more than 52 years of experience in diversified fields and author of twenty-five technical papers in international journals, said that the main human-induced sources of Air pollution are power plants, automobiles, waste management, deforestation and others. Since the industrial revolution, the concentration of greenhouse gases in the atmosphere has disrupted the earth's delicate climate balance, causing a rise in global temperature. He said that this mammoth issue of environmental pollution is self-inflicted by humans. He mentioned several verses of the Holy Quran describing the ill effects of the human actions on the environment. Engr. Kirmani said that the Islamic perspective to control Environmental pollution based on the teaching of Quran and Sunnah is the best ethical code of conduct to build a low-emission climate resilient future.

Engr. Rizwan Ahmad, the Chairman of IEPSAC Eastern region and Guest of Honor on the occasion, appreciated the informative presentation by Engr. Kirmani. The chief guest, Mr. Mahmoud Lateef said that it is an irony that the developed countries in general enjoy clean environment and good quality of life, while the 3rd world countries, like Pakistan suffer from the environmental pollution issues caused by industrial powers of the world. Engr. Syed Muhammad Iqbal, the chairman of IEPSAC, said that IEPSAC had been instrumental in raising the awareness on the important global issues from engineering perspective. He thanked the attendees of the event for making it a successful seminar through their participation.

IEPSAC Mid-Term Seminar

Rector, NUTECH PAKISTAN, LT. GEN. (RTD) Khalid Asghar delivered a seminar on the topic "Pakistan's Need for Vocational Education and Training" on Dec 30, 2019. The Chief Guest on the occasion was the Ambassador of Pakistan, his Excellency Raja Ali Ejaz. Gen. (RTD) Khalid

Asghar said that Human resource development is our national imperative. Well-structured Engineering Technologies and Skills education through Vocational institutions is the only way forward for us. With this objective in mind, National University of Technology (NUTECH) is established as a pioneer 'University for Industry' to create, develop and promote emerging technologies and skills for the country.

The Ambassador of Pakistan to Saudi Arabia, His Excellency Raja Ali Ejaz informed the audience that MoU was signed between NUTECH and Saudi Institutions during the visit of Gen. Khalid Asghar to Saudi Arabia. He also appreciated IEPSAC for arranging a seminar on Vocational training on a short notice once the availability of Gen. Khalid Asghar was confirmed.

Family Picnic

Annual family picnic was arranged on Friday, Feb 07 2020 at a venue in Muzahimiyah. This yearly event has become a tradition for IEPSAC where people enjoy relaxing atmosphere and fun activities all day long. Activities were arranged for every age group and kept the families engaged for the whole day. Several dignitaries from the Embassy of Pakistan in Saudi Arabia attended the event along with their families. Children were enthralled to compete in various games organized. Youth had a chance to burn their energies in Cricket, table tennis and several other group activities. Large crowds were gathered to watch the teams compete in Cricket tournament, tug of war and musical chair. Poetic and literary values mesmerized the participants during the Musha'era and Quiz competition. Numerous gifts were given during the lucky draw session. Female section was ever energetic with games, performance, riddles, jokes and enjoyment for all age groups. A local caterer provided delicious breakfast and lunch prepared at the venue. Tea and snacks were made available during the whole day.

First Online Mid-Term Seminar

Due to unexpected and uncertain pandemic situation, the Annual seminar of IEPSAC could not be arranged in summer. Therefore, the council decided to conduct an online seminar for the local Pakistani Engineers community. The online event was organized on Thurs Sep 10, 2020. Prof. Dr. Sarosh Hashmat Lodi, the VC of NED University of Engineering and Technology was the keynote speaker who delivered a lecture on a very relevant topic for overseas Pakistani community "University Industry Liaison and Pakistani Diaspora".

In his presentation, Dr Sarosh Lodi said that the rapid technological development in recent past has been reshaping the modern world by revolutionizing the industrial practices. To bridge the gap between academic knowledge and industrial practices, it is critically important to strengthen the linkage between academia and industry. From industry perspective, University-Industry Linkage (UIL) is effective in terms of having technological development at lower cost of research by virtue of availability of low-cost workforce as students and faculty of University are at one place. From university perspective, academicians get to know the latest demand of the local, national and international markets. Dr Lodi said that Pakistani Diaspora can play a vital role in bridging the gap between industry and academia.

The Chief Guest of the event and Political Office at the Embassy of Pakistan, Mr. Saif appreciated the models presented by Dr Lodi in his presentation. He also commended the seminar

arrangement by IEPSAC on this relevant topic.

IEPSAC Central Region Council

The approved by-laws of IEPSAC necessitates the election of the Chairman at the end of the biennial term. The election was conducted on Oct 23, 2020. The Council re-elected Engr. S. M. Iqbal as the chairman of IEP-SAC for the next biennial term of 2021-22. Engr. Iqbal said that he was humbled by the demonstration of trust and confidence on him by the council members. He attributed the successes of the organization during the past two years to the Help of Allah SWT and excellent teamwork of council members. He nominated Engr. Asim Siddiqui as the General secretary, who later on nominated Engr. Farooq Iqbal as the Joint secretary of the organization. The council ratified the nominations and appreciated their capabilities and offered full support to them.

The convener of IEPSAC Scholarship committee, Engr. Shaikh Akhtar Hussain shifted to Canada after his retirement from the company. The Council thanked him for his instrumental role in driving the scholarship program of IEPSAC and bid him farewell. Two new members, Engr. Imran Ashraf and Engr. Dr. Fakhir Hasni joined the council in early 2020. The council hoped that their profiles and caliber would be a valuable addition to the council and would help towards the causes of IEPSAC.

IEP-SAC has three (3) centers in KSA, comprising a main center in Riyadh (Central Region) and two sub-centers in Eastern and Western regions. All centers are very active in organizing various technical seminars and other social events mainly for the Pakistani engineering community in KSA. Detailed reports about the activities of the sub-centers from their chairmen with photographs are also included on the subsequent pages of this annual journal.

We express our gratitude to the Custodian of the Two Holy Mosques, King Salman Bin Abdul Aziz and the Crown Prince Muhammad Bin Salman for facilitating Pakistanis in general and Pakistani engineering community in particular to contribute towards the development of our brotherly country Saudi Arabia. We are also thankful to the patronage and support of the Ambassador of Pakistan His Excellency Raja Ali Ejaz and his team throughout the year. The contribution of IEP-SAC Eastern region (Engr. Rizwan Ahmed and his local council members) in raising the funds for our scholarship program is highly appreciated. I wish to extend my thanks to all engineers, sponsors, advertisers, press/media personnel and well-wishers for their cooperation and continuous support to IEP-SAC.

Warmest Regards,

Engr. Mohammad Asim Siddiqui

General Secretary, IEPSAC

Report from Award and Scholarships committee

An Engineer plays an important role in the development of any country and build a better world. IEP-SAC, Saudi Arabian Chapter of The Institute of Engineers Pakistan under the patronage of the Embassy of Islamic Republic of Pakistan in Saudi Arabia along with other technical and social activities is also playing its role in supporting Engineering education in Pakistan.

By the grace of Allah the Almighty, the IEP-SAC scholarship program for needy and academically sound students in the Engineering Universities and Colleges of Pakistan was launched 23 years ago in the year 1996. With the joint efforts of IEP-SAC, Local Council members, and others, it has been expanding ever since and presently 96 students from the below listed 12 public-sector universities and colleges are benefiting from this program.

1. University of Engineering and Technology, Lahore
2. University of Engineering and Technology, Taxila
3. University College of Engineering and Technology (Bahauddin Zakariya University), Multan
4. Institute of Chemical Engineering and Technology (University of the Punjab), Lahore
5. Dawood University of Engineering and Technology, Karachi
6. NED University of Engineering and Technology, Karachi
7. Mehran University of Engineering and Technology, Jamshoro
8. Quaid-e-Awam University of Engineering Sciences and Technology, Nawabshah
9. NWFP University of Engineering and Technology, Peshawar
10. Baluchistan University of Engineering and Technology, Khuzdar
11. Mirpur University of Science and Technology, Mirpur (AJ&K)
12. Khawja Fareed University of Engineering and Information Technology, Rahim Yar Khan

As can be noted from the list, this scholarship program serves all the four provinces of the Islamic Republic of Pakistan and the State of Azad Jammu and Kashmir. The rules and regulations, selection criteria and application forms can be accessed and printed from IEPSAC website. By the blessings of Allah the Almighty, 21 batches of the scholarships have been completed so far and 22nd batch was launched in September 2019, benefiting meritorious and needy students from this scholarship program who will serve the humanity and our homeland after graduation.

The continuity of IEP-SAC scholarship program has not only been maintained during last 23 years, but it has also been expanding gradually with the help of financial contributions from various philanthropists, individuals, and organizations in Saudi Arabia. I take the opportunity to offer the readers of these lines in general and the Pakistani community and engineers in particular to join hands with us in this noble and just cause. It is a great service to the Engineering community in Pakistan. It is my humble request to all to put our maximum efforts in contributing and expanding the scholarship program to the needy and deserving engineering students in Pakistan.

Your suggestions to improve this noble cause further will be most welcomed. Please do not hesitate to contact any of the members of IEP-SAC Awards and Scholarships Committee or Local Council for any suggestion or information.

Arch. Farooq Iqbal, Convener

IEP-SAC Awards and Scholarships Committee

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IEP-SAC Local Council 2020-21

Central Region

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Chairman
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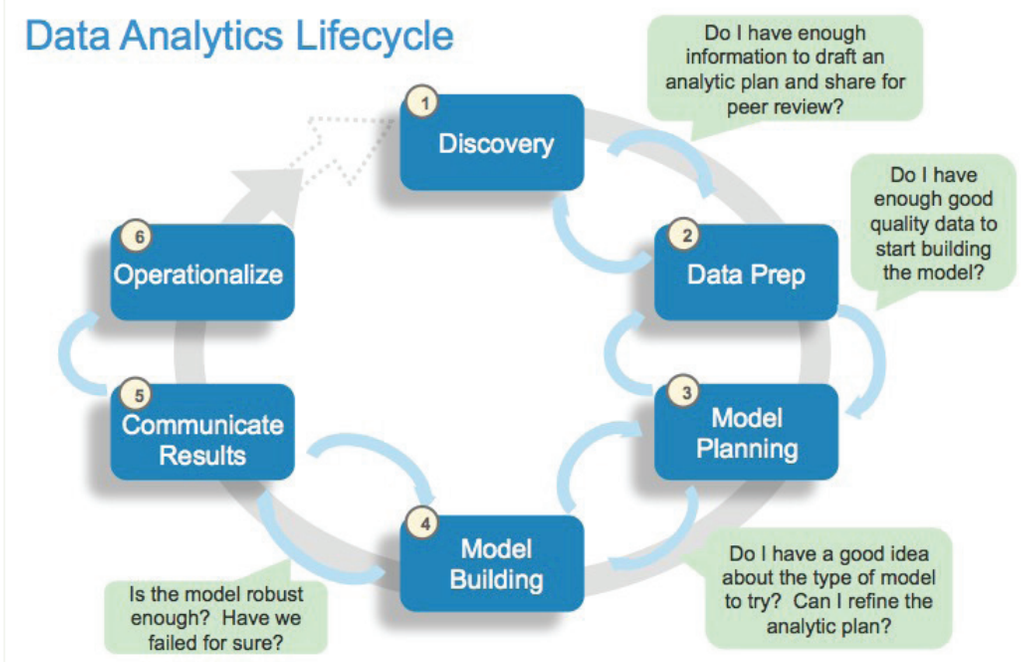
What is Data Science?

Data Science is a blend of various tools, algorithms, and machine learning principles with the goal to discover hidden patterns from the raw data. How is this different from what statisticians have been doing for years?

The answer lies in the difference between explaining and predicting.

Data science continues to evolve as one of the most promising and in-demand career paths for skilled professionals. Today, successful data professionals understand that they must advance past the traditional skills of analysing large amounts of data, data mining, and programming skills. In order to uncover useful intelligence for their organizations, data scientists must master the full spectrum of the data science life cycle and possess a level of flexibility and understanding to maximize returns at each phase of the process.



SCENES FROM IEP–SAC **Activities**

CENTRAL REGION

Family Picnic












SCENES FROM IEP–SAC Activities

CENTRAL REGION

52nd IEP SAC Technical Seminar

Environmental Pollution: Causes, Effects and Control with Emphasis on Islamic Perpective


Control with E
Friday, 22nd Nov, 2019


"Environmental Pollution: Causes, Effects and Control with Emphasis on Islamic Perspective"
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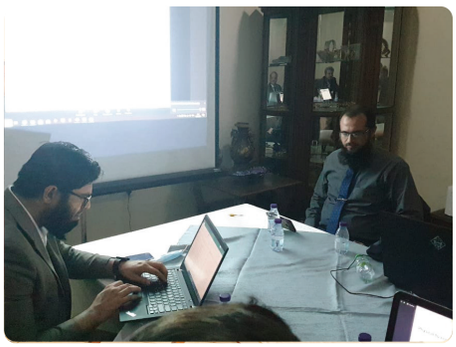
SCENES FROM IEP–SAC **Activities**

CENTRAL REGION

First Online Mid-Term Seminar

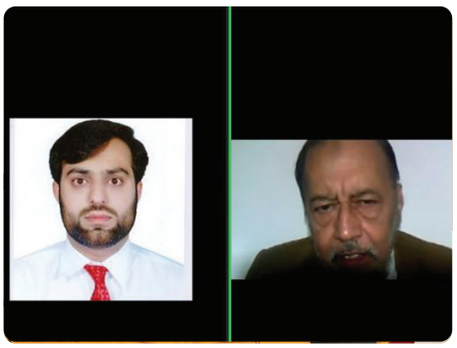


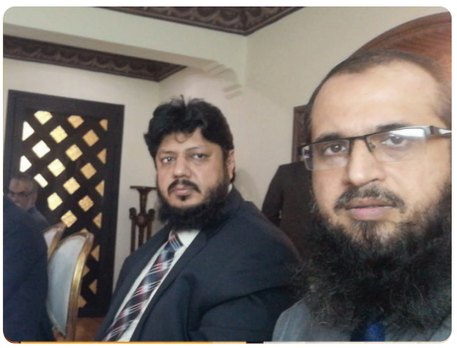










Message from Chairman IEP-EP

The Almighty blessed us with the Islamic republic of Pakistan on 14th August 1947 and put it on the horizon of the world map. The dream of Sir Allama Muhammad Iqbal, around December 1930, was later espoused by M. Ali Jinnah in the "Two Nation Theory" and adopted into the famous 23rd March 1940 Lahore resolution.

Allama Iqbal's dream came true eventually with a total area of 796096 sq. km and a now thriving 203 million inhabitants. Pakistan is home to K-2, the second highest peak of the world, with 108 peaks above 7000 meters including 5 of the world's 14 highest independent peaks.

The first Muslim nuclear power, having over 150 universities, 400 technical and vocational institutions, Pakistan also boasts the world's largest earth filled dam, Tarbela Dam, and has the world's biggest canal irrigation system.

Helping to build a Better Pakistan, the Institution of Engineers Pakistan (IEP) was founded with the blessing of the father of the nation, Quaid-e-Azam Muhammad Ali Jinnah in 1948, and has now expanded to 10 centres in Pakistan and overseas centres in Kingdom of Saudi Arabia for more than 22 years.

IEP is member of:

- World Federation of Engineering Organization
- Consortium of Affiliates for International Program
- Federation of Engineering Institutions of Islamic countries
- Federation of Engineering Institutions of South and Central Asia
- Commonwealth Engineers Council

- American Association for Advancement of Science (AAAS)
- 33 other Foreign Professional Societies

Eastern province sub-centre is actively performing its roles and responsibilities to establish and promote excellent relationship and interaction among its members and other professionals. We provide opportunities for the exchange of engineering and scientific information, organize technical visits, research studies, conferences, seminars and workshops on engineering subjects.

We have organized following technical seminars this year:

1. "Global issues of water scarcity with

special reference to Pakistan" by Engr. Syed Mubashir H. Kirmani.

The discussion focuses on the fact that several countries in the world including Pakistan are approaching from water stress to water Scarcity Phase. In this presentation, Strategies to mitigate the water issues and possible options of building large and small dams in Pakistan and a comparative study of possible Large Dams was discussed.

2. "Combating Cybersecurity Challenges in Smart Cities" by Prof. Muhammad Khurram Khan.

   The increase in connectivity of smart cities may expose them to a diverse set of Cybersecurity risks, which could put the entire city operations and lives of its inhabitants at jeopardy. In this speech, we explored various technical and technological concerns that could be faced by the smart cities along with research contributions as future directions in this domain.

3. "A practical perspective on disruptive interventions for smart mobility and traffic safety deployments in Saudi Arabia" by Engr. Muhammad Farhan Butt, Dr.

Road traffic injuries account for 30% of all deaths worldwide and are one of the major causes of death among people 15–29 years old. Saudi Aramco chair for traffic safety research, in collaboration with stakeholders, is making a real difference by conducting applied scientific research on deployment of impactful mitigation measures in Saudi Arabia. This webinar highlights some of the key efforts made by Aramco safety chair on the subject.

We appreciate support of our sponsors, fellow engineers, local industries, Saudi Council of engineers and Jordanian Engineers Association for their valuable contribution in our success.

Finally, Thanking Almighty ALLAH for providing us resources, energy and opportunities to serve our engineering community.

Rizwan Ahmed,

Chairman,
IEP-SAC-EP

IEP-SAC-EP Council 2020;
Eastern Region

IEP-SAC Journal 2020-2021

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IEP-SAC Journal 2020-21

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Annual Event, graced by H. E. Raja Ali Ejaz, Ambassador of Pakistan in Kingdom of Saudi Arabia, on the topic of "Global Issues of Water Scarcity with Special Reference to Pakistan" by Engr. Syed Mubashir H.

Kirmani held on March 14, 2019 at Karawan Compound Community Hall, Al Khobar.

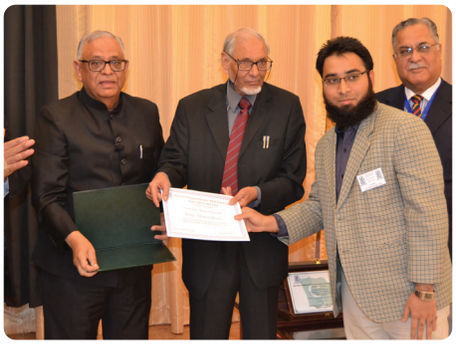
SCENES FROM IEP–SAC **Activities**

EASTERN REGION









Technical Seminar on the topic of "Combating Cybersecurity Challenges in Smart Cities" by Prof. Muhammad Khurram Khan held on November 21, 2019 at Karawan Compound Community Hall, Al Khobar.

SCENES FROM IEP-SAC **Activities**

EASTERN REGION












Policy and Engineering Considerations for Pakistan's Water Security Challenge

Shahbaz Khan

*UNESCO Regional Science Bureau for Asia and the Pacific

Abstract

Pakistan is a country already facing water shortages for urban as well as rural water uses. A number of comprehensive water sector reports, a climate change policy and a national water policy exist but implementation remains limited due to financial, political and institutional challenges. The Indus river basin water system is the backbone of the water security in Pakistan and is suffering structural and non-structural issues of adequate water storage, timely water conveyance, efficient water distribution, and appropriate consumptive use challenges. Inspirational integrated approaches such as Integrated Water Resources Management could not be implemented due to national and provincial mandates on the management of surface and ground waters and associated equitable distribution of costs and benefits among stakeholders. This paper presents an overview of the challenges and possible policy and engineering options through a diagnostic water balance analysis considering population, cropping patterns, system efficiencies and storage options.

Keywords

Efficiency, climate responsive, irrigation, Indus storage, water balance diagnostics, SDGs

Introduction

Pakistan is a country characterised by great landscape variations from snow-covered northern mountains to irrigated floodplains of Indus, vast coastal lands and extremely dry desserts of the Balochistan Plateau. The Indus Valley civilization dates back to the Bronze Civilization approximately to 5500 BCE, and was founded on abundance of water supplies to the fertile floodplains. Since independence in 1947 Pakistan has been struggling with managing its water resources as more than one third of the water resources have origins outside of Pakistan. This has resulted in water-distribution treaty between India and

Pakistan, brokered by the World Bank in 1960, giving control over waters of Beas, the Ravi and the Sutlej to India, while control over the water flowing in the Indus, the Chenab and the Jhelum, which constitute major source of water to this vast agrarian economy, was given to Pakistan. With rising population and increasing demands for water, water security has been becoming a major concern as the per capita annual water availability has dropped from 5,260 cubic meters in 1947 to less than 1,000 cubic meters in 2018. According to some studies, Pakistan is ranked 46 among 48 nations in the Asia-Pacific region, with only Kiribati and Afghanistan having a lower water security index. Pakistan is also among the top 10 most climate vulnerable countries in the world. The looming shortages and worsening quality of water have become serious threats to food, health, energy, job security and, therefore, to the delivery of 2030 Agenda for Sustainable Development Goals (SDGs). Cities have run out of safe drinking water, agriculture shows lower crop yields as crops remain thirsty, there are vast salinized floodplains below Kotri Barrage, and drying polluted wetlands like Lake Manchar have become sad environmental disasters. A National Water Policy (Government of Pakistan 2018) and a National Climate Policy (Government of Pakistan 2012) exist, but the crisis seems to become worse as implementation roadmaps and action plans are missing. This situation requires extraordinary measures as business-as-usual is no longer an option. This article provides a diagnostic water balance analysis of existing data on water availability, water demands, future water availability scenarios and implementable solutions to lead Pakistan from water scarcity to water security.

Water Balance Diagnostics

A schematic of the Indus water system showing the main rivers of Jhelum, Chenab, Ravi, Sutlej and Indus, along with the key river and water infrastructure is given in Figure 1. The storage capacity and water diversion capacities are given in Million Acre Feet (MAF). The key statistics of the Indus river system are: three major water reservoirs with combined capacity of 13.86 MAF, power generation capacity of 6902 MW, 18 water diversion barrages, 45 main canals with a total length of 56,073 km, 12 link canals between rivers with a total length of over 700 km and 107,000 km of water courses. The Kotri barrage is the furthest downstream water diversion barrage for irrigation.

According to 2030 Agenda, Sustainable Development Goal 6 is to ensure water security leaving no one behind. To implement 2030 Agenda SDG 6 we need a paradigm shift from issues to solutions (Khan 2016). According to the UNESCO International Hydrological Program (IHP), water security

Figure 1. Schematic of water system and key infrastructure (Ministry of Water Resources and others)

is defined as "the capacity of a population to safeguard access to adequate quantities of water of acceptable quality for sustaining human and ecosystem health on a watershed basis, and to ensure efficient protection of life and property against water related hazards -- floods, landslides, land subsidence, and droughts". UNESCO IHP, 2012).

The diagnostic analysis shows that for a period of forty years (1977 to 2017) the minimum, maximum and average flows in Indus River are 67, 112 and 90 MAF, respectively. The same statistics for Chenab River are 18, 33 and 26 MAF, respectively, and for Jhelum River are 12, 32 and 23 MAF, respectively. The overall minimum, maximum and average availability of water from these rivers is 99, 183 and 144 MAF, respectively (Figure 2).

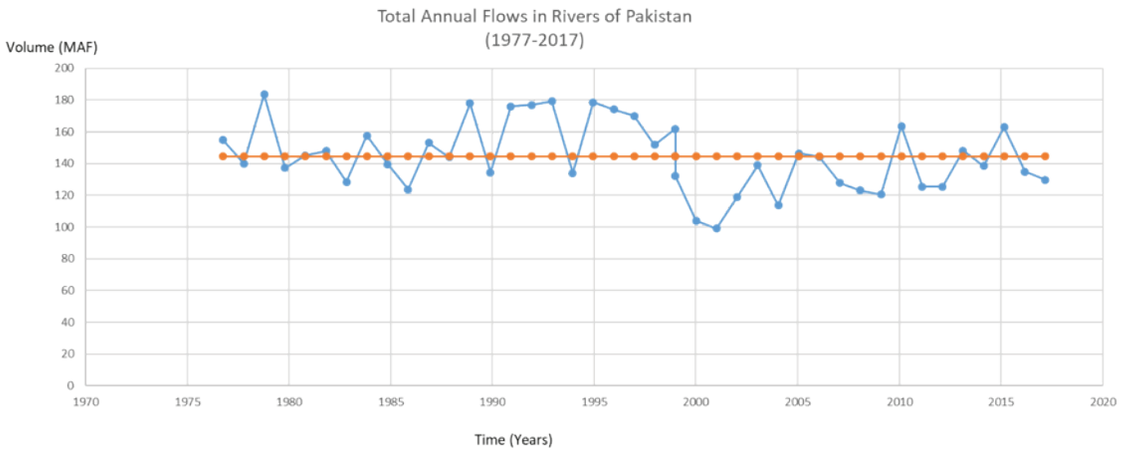


Figure 2 Total Annual Surface Water Flows in Pakistan (1977-2017)

The effective water available from underground water recharges from rivers and the vast irrigation system is estimated to be around 50 MAF. There are several key questions to be answered. Are these water resources and rainfall over the irrigated and arid (barani) areas enough for consumptive water uses? Is too much water escaping the productive use below the Kotri Barrage to the ocean? Additionally, Pakistan's water storage capacity from existing large dams Mangla and Tarbela is less than 14 MAF and is continuously decreasing due to sedimentation. Another key question is: Can an additional 6 to 10 MAF of water from planned dams make Pakistan water secure?

Figure 3 gives an overview of water flows for last forty years below Kotri Barrage, showing maximum, minimum and average flows as 92, 0.3, and 27 MAF, respectively. There has been many years (e.g. from 2002-2003) when there were no substantial flows downstream of Kotri Barrage, which means all the available water was diverted due to low supplies. Under such future scenarios, will managers be able to fill existing and new dams? A close examination of the water balance of Pakistan shows water losses from dams to fields and within the farmer fields of from 25 to 50 percent, due to the use of flood irrigation and poor system management (Khan et al 2006). Such losses are too high by international standards. Some of these losses can be recovered through t extra expense of energy to pump from the groundwater, while others are unrecoverable as they end up in saline, unusable groundwater or evaporate back to the skies.

The storage yield curves of the Indus river basin show good potential for 20 MAF of surface water storage. Given the data showing the history of low flows below Kotri, there will be years when managers will be unable to fill existing storages. The existing dams and network of barrages and canals have been

able to divert around 105 MAF successfully. The additional surface storages can store around 10 MAF flows in the Indus Basin during normal and flood years. During flood years (e.g. 2010) more than 50 MAF of water flowed below Kotri Barrage. During such years there is an option of using these flows to recharge groundwater by diverting floods to the thirsty landscapes such as Thar.

Many of the summer crops grown in Pakistan, such as rice and sugarcane, demand the highest amounts of water to grow them. Meanwhile, the largest winter crop and staple food crop, wheat, remains under irrigated. Can there be options to limit area of rice and sugar cane and tailor Pakistan's cropping patterns to present and future water availability?

A diagnostic water balance analysis scenario developed by the author based on existing frameworks given by Khan et al (2010) and Kang at al 2009 climate change impacts review is presented in Table 1. The water security is calculated based on the available data of flows, groundwater availability, rainfall, projection of population to 245 million persons, construction of additional dams (e.g. with 10 MAF storage), and climate change impacts for a possible 2 degree rise in temperature, to understand water deficits. Other unpublished scenarios are available and not quoted here for brevity reasons.

Table 1. Diagnostic water balance analysis (Source: Author)

% Water Deficiency	Scenario
35	2030 water deficit Business as usual 2C temp rise
31	With dams by 2030 but business as Usual 2C Temp Change
13	2030 with dams and 50 efficiency gains
0	2030 with dams, increased efficiency and changed cropping patterns

The rough percent water deficiencies in Table 1 indicate the net difference of total water supply and demand – these numbers may need further improvement through detailed data and analysis. The business as usual assumes current inefficient water supply and water use practices.

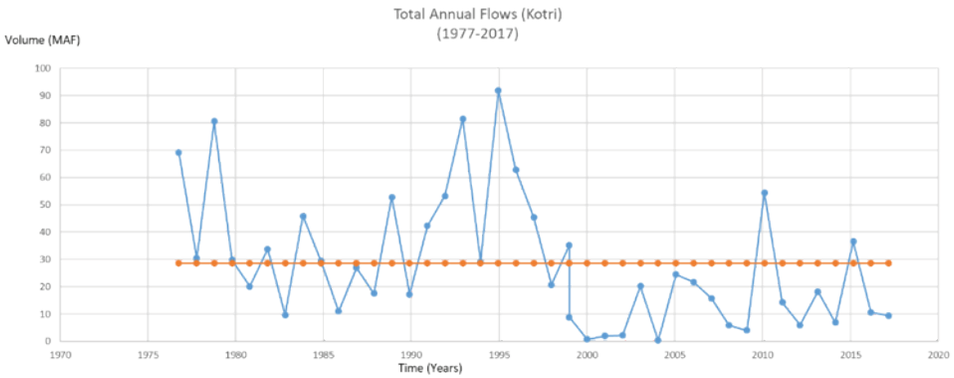


Figure 3. Annual Flows in River Indus Below Kotri Barrage (1977-2017)

Plausible Policy Options in a Nutshell

In a nutshell, dams and artificial recharge of aquifers are urgently needed, but increased water storage capacity in Pakistan cannot solve the water security problem alone. Similar conclusions were drawn for the Murray-Darling Basin by Khan et al 2007. A key conclusion from these scenarios is there is a need to invest in more dams as well as

invest in water savings and appropriate storage options. Greater gains need to be made by saving the huge water losses (equivalent to storage of over 5 new dams) through investment in proven water efficiency technologies (Khan et al 2007 a and b). At the farm level such technologies can include the use of drones for cropping mapping, water control devices such as smart valves, laser levelling, cheap drip irrigation, wetting front detection systems, crops on beds etc. to reduce water losses. There can also be investment in leakage hotspot to reduce losses from the supply system to saline groundwater and reduce unproductive evaporation in the system. To improve water availability one can recommend rooftop and micro catchment harvesting, artificial recharge of areas such as Thar with flood waters, and storage of water in soils through conservation measures such as using polymers and other technologies. Given the transboundary nature of water resources, with over 30 percent of water supplies coming from upper catchments of Jhelum and Chenab rivers across the borders, there is a need to construct a minimum linkage infrastructure. For example, linking Indus River below Tarbela Dam with Jhelum River to be able to supply minimum water needs for strategic water and food security plans.

Where can be the practical entry points for the road to a water secure Pakistan? Many studies are available, for example, Water Sector Task Force (WSTF) Islamabad (2012), but implementation remains limited. The urgent need is to provide safe drinking water as a basic human right to all citizens of Pakistan. There can be interesting learning from the example of South Africa where 25 litres/capita/day is adopted as a basic human right, free of charge, after which there is a sharply increasing pricing regime. If one uses such an approach, less than 2 MAF are needed to provide basic water supply to all Pakistanis. The author recommends adopting a 100 litres/capita/day and replacing hazardous groundwater with surface water supplies from canals running close to our cities such as Lahore and Faisalabad, and provide desalinised seawater to cities such as Karachi. Land based wastewater treatment such as being used by the National University of Science and Technology (NUST), through a UNESCO project, can provide economical solution to treat waste waters from the cities, which are currently being used to grow unsafe vegetables in the surroundings of most cities.

The existing water institutions and governance system has been unable to tackle the water security challenge of Pakistan. There is a need for a National Water Commission working under the directions of the National Water Council representing all stakeholders. Reforms to water education and continuous professional development are needed through international collaborations. A national research university of water management similar to Hohai University in China is recommended, closely linked with the Ministry of Water Resources. The schematic of a water roadmap is given in Figure 4.

There must be a focus on improved governance, trans-boundary data availability and more extensive water investments in controlling analysis at the urban water supply system and irrigation districts levels for targeted improvement of water efficiency, availability and water equity. A sustained 10-year effort is needed for a Water Secure Pakistan, including construction of critical water infrastructure (dams and artificial recharge of aquifers), governance according to 21st century water management standards, and technology for water resilience and water efficiency. The business-as-usual approach is no longer an option for Pakistan!

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An abridged version of this article titled "Pakistan's water economy: getting the balance right" by the author was published in Daily Tribune July 28, 2018 and an expanded version

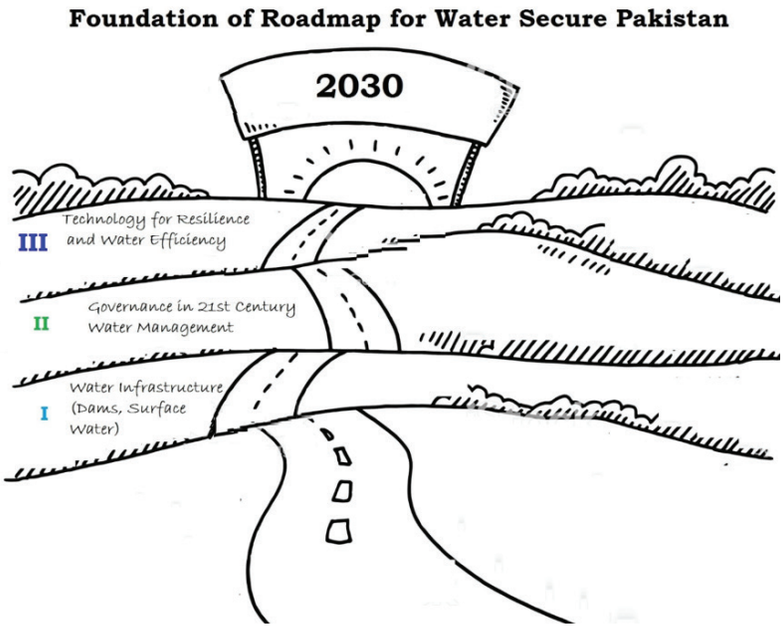

Figure 4. Elements of a Possible Water Security Roadmap for Pakistan

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Subcontracting Practices on Construction Projects in Pakistan

By

Prof. Dr. Rafiq Muhammad Choudhry

Abstract

Contractors undertake the services of subcontractors to achieve certain objectives such as obtaining cost reductions, risk sharing and securing access to specialized services. Subcontracting practices in the construction industry of Pakistan led to identification of the main problem areas. This not only helps examine the overall satisfaction and the quality of service provided by subcontractors but also focuses on ways to improve the quality of construction. A questionnaire survey was conducted to investigate the extent and involvement of construction firms in subcontracting, reasons for subcontracting, and the selection criteria of subcontractors. Additionally, interviews were conducted with researchers, professionals and experts of the industry. The results revealed a widespread use of subcontracting and sub-subcontracting in the construction industry, primarily done to save time and money. Results show that 53% of the respondents are satisfied with their current subcontracting experiences, whereas 47% of the respondents want positive changes to be made in subcontracting arrangements. The findings of this research will help subcontractors to improve their performance and assist stakeholders in the successful execution of a quality project through the judicious employment of subcontractors.

Introduction

Prime contractors rely heavily upon the

specialized services of subcontractors to reduce costs and increase efficiency on construction projects. Through their specialized services, subcontractors execute specific tasks that prime contractors could not perform efficiently (Markowitz 2007). These tasks are assigned to lower-tier contractors known as subcontractors. On numerous building projects, commonly 80% to 90% of the tasks are performed by subcontractors (Hinze and Tracey 1994). Most prime contractors sublet large portions or all of the specialized work on their projects due to their inability to perform specialist tasks, e.g. plumbing, electrical work and insulation etc. While prime contractors are commonly known to sublet portions of their work, subcontractors also sublet a portion of their contract to other specialized firms, commonly known as lower-tier subcontractors or sub-subcontractors.

In the housing sector of Hong Kong the employment of direct labor accounts for around 1% of the construction work whereas 99% of the work is subcontracted (Lai 1987). The extensive practice of subcontracting is also reported in other countries, including the UK (Flanagan and Gray 1989) and Japan (Kimura 2002). It is argued that prime contractors maximize their profits by minimizing their performance costs through subcontracting (Richter 1982).

Subcontracting is practiced for a variety of reasons. It is not possible for companies to own, operate, control, and maintain specialized plant and equipment as these generally receive limited usage on a typical project (John 1991). Because of these unique skills, subcontractors are able to execute their specialized work tasks more efficiently and at a lower cost than prime contractors (Lin 2003).

In the construction industry of Pakistan, subcontracting practices are extensively used in residential, commercial and civil engineering projects. Even though a major portion of a construction project is usually executed by subcontractors, the issues regarding subcontracting are seldom acknowledged and addressed. The objective of this research was to examine the existing subcontracting practices in the construction industry of Pakistan, identify the major problem areas and to explore the overall satisfaction with the quality of service provided by subcontractors in Pakistan.

Methodology

This study used mixed research method and a questionnaire survey was utilized as the main research instrument. It was decided that the information would be obtained through mailed questionnaires and personal interviews, which would yield detailed information. A detailed literature review was conducted and a number of questionnaires (developed by other researchers) were examined. Tailoring the study to the construction industry of Pakistan, the survey instrument was finalized based on the research of Sit and Wong (1989) and John (1991). The questionnaire was further modified by incorporating feedback of the pilot survey to suit it for the construction industry. For this purpose, ten questionnaires were presented in different organization: universities (2), clients (2), consultants (2) and contractors / subcontractors (4), followed by interviews with each participant. A five-point scale with one being 'extremely important' and five being 'not important' was utilized to solicit the perceptions on the degree of importance of various practices.

The questionnaire was sent to top registered firms with the Pakistan Engineering Council (PEC), including clients, consultants and contractors. According to PEC data, the number of building and civil engineering establishments registered in Pakistan reached 26,000. For this population size, Dillman (2000) provided a sample size of 61 is enough with ±10% sampling error and for 95% confidence level. Random sampling is good when population structure have no significant variation. In this research, the judgmental sampling method is used and

the questionnaires were sent to 130 top registered firms: clients (30), consultants (30), and contractors / subcontractors (70). Out of the 130 questionnaires sent out, 69 were returned for final analysis. These included responses from 17 clients, 19 consultants and 33 contractors / subcontractors. This represented a response rate of 56.7%, 63.3% and 47.1% respectively. Table 1 shows an overall response rate of 53%.

filled the questionnaire. The respondents were initially contacted by telephone or email followed by face-to-face interview. Duration of each interview was 45 minutes to 1 hour. After conducting twelve (12) interviews, saturation was reached and efforts were diverted towards analysis. Executive Directors had extensive management as well as far-reaching experience in subcontracting and provided valuable information to the researchers.

Table 1. Responses to the Questionnaire

Groups	Questionnaires Sent	Questionnaires Returned	Response Rate
Clients	30	17	56.7%
Consultants	30	19	63.3%
Contractors/ Subcontractors	70	33	47.1%
Total	130	69	53.0%

According to Owen and Jones (1994), a response rate of 20% is considered satisfactory. In construction, a good response rate is around 30% (Black et al. 2000), therefore, the response rate in this research is considered acceptable. Respondents were amply qualified and experienced in the construction industry. Approximately 55% of the respondents had accumulated over 10 years of construction experience, while 45% had 5 to 10 years of construction-related experience. Interviews were conducted to complement and validate the survey questionnaire. Only executive directors of the companies were interviewed as they were supposed to possess the maximum knowledge regarding the firm's existing practices on subcontracting and their pros and cons. These interviews were conducted with the respondents who had

The collected data were analyzed using the Statistical Package for Social Sciences (SPSS) through frequency analysis, relative importance by mean scores, and one-way ANOVA or Kruskal-Wallis tests for parametric and non-parametric data to find out significant differences between responses of client, consultants and contractors on any particular aspects of subcontracting. The "Kruskal-Wallis test" is used for non-parametric data whereas "one way ANOVA" is used for parametric data. In this research, ranking is based on sample population mean. A 0.05% level of significance was considered to represent statistically significant relationships in the data.

Results and Analysis

Of the respondents, 80% represent building construction and the other 20% worked on civil engineering projects. The number of full-

time employees of the respondent organizations varied from one to six hundred (mean = 173 and mode = 85), resulting in considerable diversification among the respondents. The number of subcontractors on the lists of the companies varied from 5 to 200 (mean = 65.51 and mode = 50). The firms were between 3 to 36 years old with an average of 17 years (mode = 20 years).

Existing Subcontracting Practices

The results show that subcontracting is indeed very extensive. Out of 69 respondents, 55% responded that they 'always' and 42% that they 'mostly' subcontracted at least some portion of their projects. None of the respondents stated that they 'occasionally' or 'never' subcontracted any of their project work (see Fig. 1).

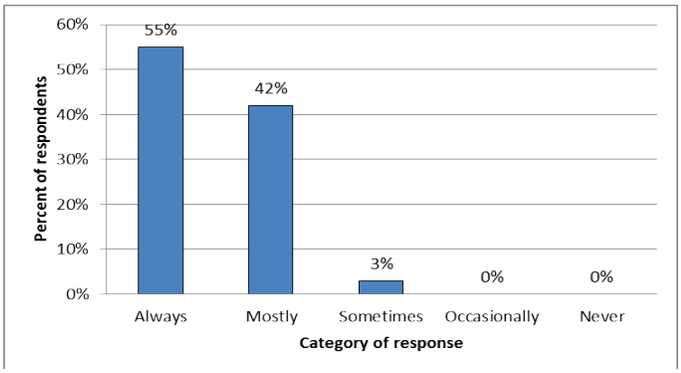

Fig. 1. Frequency of subcontracting by respondents

Respondents confirmed the extensive practice of sub-subcontracting in the construction industry, as 43% of the respondents stated that they 'mostly' and 32% stated that they 'sometimes' practiced or observed the practice of sub-subcontracting on their projects (see Fig. 2). The information gleaned from the interviews revealed that the respondents consider the current subcontracting system to be very complex. The primary source of the complexity is attributed to the practice of subcontractors awarding contracts to lower-tier subcontractors, or sub-subcontractors. When multiple tiers of subcontractors exist on a project, communication links between the client and the subcontractors are weakened. This makes it difficult for the client to communicate directly with some of those firms that actually perform the work. Interviews further revealed that the subcontracting practices are fostered by either domestic subcontractors that are hired by the prime contractor or nominated subcontractors, which in turn, are firms that are pre-selected by the client, but the subcontract that they enter establishes a binding contract solely with the prime contractor. Respondents stated that domestic subcontractors are employed in labor-intensive tasks such as excavating, formwork, rebar work and painting. Nominated subcontractors are most commonly employed for work involving piling, HVAC, elevators and in other specialized work.

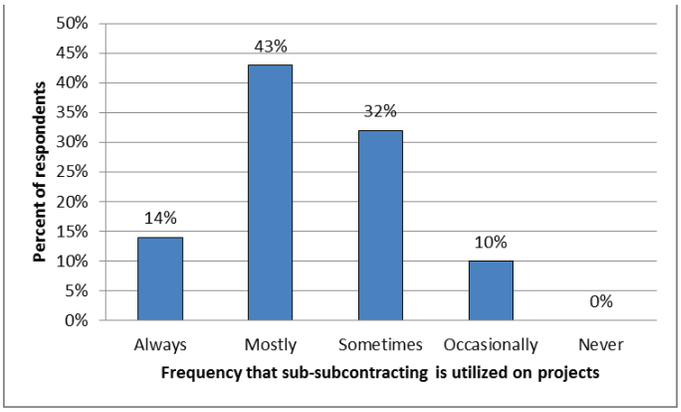

Fig. 2. Frequency that sub-subcontracting is utilized on projects

When asked about the resources provided by subcontractors, respondents stated that labor was commonly the only resource provided by the subcontractors. It is not common for subcontractors to provide materials (see Table 2). The mean value for providing labor is 1.36 indicating it lies between 'always' and 'mostly' indicating that labor is often provided by the subcontractors. Providing plant and equipment and providing materials with means of 2.68 and 2.74, respectively, lie between 'mostly' and "sometimes'. The results show that labor resources are the most

commonly provided resources. The values of the Kruskal Wallis Test (labor = 0.838), (plant = 0.143) and (material = 0.825), demonstrate that plants are rarely provided by subcontractors. Research participants were asked about the reasons for subcontracting their work. Out of nine choices given, multiple reasons were selected for opting to subcontrat (see Table 3). The most common reasons are to save time (mean=2.04), save costs (mean=2.07), absorb price instability (mean = 2.20) and to gain access to specialized skills that are lacking in the firm (mean=2.57). Regarding the selection of subcontractors, respondents revealed that there are no prequalification criteria for the selection of subcontractors. Contrary to prime contractors, there is no requirement for the registration of subcontractors in Pakistan. Most subcontractor selections are made from a list prepared by the prime contractors, generally based on the experience gained from working with the subcontractors on previous projects.

Almost 94% of the respondents revealed that they review their list of subcontractors periodically with particular emphasis paid to performance, while the remaining 6% stated that they had no system of evaluating subcontractors. The most widely used method of developing a slate of viable subcontractor is through their own maintained lists (mean = 1.59); second is negotiation (mean = 2.70); followed by open bidding (mean = 3.52), the least preferred method. The respondents considered the most imperative criteria for the selection of subcontractors to be the bid price (mean = 1.36), followed by the ability to complete the work on time (mean = 1.46) and lastly the quality of the work (mean = 1.64) (see Table 4). The values of the Kruskal Wallis test reveal a high level of consistency of the opinions of the three groups (clients, consultants, and contractors) on the selection criteria of subcontractors (Table 4). Results indicate that 60% of the contracts between the contractors and subcontractors are in written format and most of these do not use a standard form of contract. For contracts between subcontractors and sub-subcontractors, 21% of the respondents indicated that the contracts were in writing. Since a few sub-subcontract agreements are written, it is difficult to prevent or control the practice of subcontracting with lower-tier subcontractors. Regarding the terms of the contract, 52% of the respondents indicated that the terms of the contract are generally dictated by the prime contractor. Since the subcontractors are often not involved in the preparation of

Table 2. Responses to the Questionnaire

Resources Provided by the Subcontractor	Mean	Kruskal Wallis Test (sig)
Labor Resources	1.36	0.838
Plant and equipment	2.68	0.143
Materials	2.74	0.825

Table 3. Reasons for Subcontracting

Reasons	Traditional	Lack Specialized Skill	Beyond Capacity	Reduce Cost	Reduce Risk	Save Time	Absorb Fluctuation	Maintain Relation	Tax Advantage
Mean	3.84	2.57	3.26	2.07	3.17	2.04	2.20	3.36	4.67

1 = most common response, 5 = least common

Table 4. Basis for Selection of Subcontractors

Selection Criteria	Price	Quality	Ability to Complete Work On Time	Subcontractors Resources	Personal Relationship
Mean	1.36	1.64	1.46	1.97	3.07
Sig.	0.063	0.069	0.809	0.963	0.060
Kruskal-Wallis significant at 0.05					

contract provisions, it is understandable that this could lead to disputes.

More than 70% of the respondents stated that problems do arise due to subcontracting. 75% of the respondents stated that extensive negotiation is the most commonly used method to resolve problems with subcontractors. When asked about resolving problems with formalized methods such as arbitration or mediation, 18% of the respondents indicated that they had made use of arbitration and mediation, while 7% stated they had resorted to other legal means to resolve disputes.

Analysis of Major Problem Areas

Respondents were asked about the main problem areas of subcontracting, whether it included quality, work progress, lack of cooperation, excessive material wastage, or difficulty in coordinating activities. Respondents indicated that quality (mean = 2.35) was the major problem area of subcontracting followed by work progress (mean = 2.81) and lack of cooperation (mean = 2.94) (see Table 5). The results of the Kruskal Wallis test show that there is no significant difference of perception regarding major problem areas of subcontracting among clients, consultants and the contractors. The Kruskal Wallis test revealed a value of 0.982 (significance < 0.05) for quality (see Table 5) which shows a strong agreement of all the groups.

On the issue of construction quality, 62% of the respondents assessed quality as being 'most important' or 'important' (see Fig. 3).

Table 5. Main Problem Areas of Subcontracting

Problem Areas	Quality	Progress	Lack of Cooperation	Excessive Material Wastage	Difficult to Coordinate Activities
Relative Importance by Mean	2. 35	2. 81	2.94	3.03	3.03
Kruskal Wallis. Sig.	0.982	0.941	0.919	0.829	0.272

Interviewees revealed that subcontractors are more prone to risks and end up in bankruptcy due to the lack of business acumen among smaller enterprises. Many of these firms bid on projects without thoroughly evaluating the relevant project information. The respondents generally felt that the quality of the working environment in the construction industry is unsatisfactory and, this in turn, is an impediment towards improving construction quality.

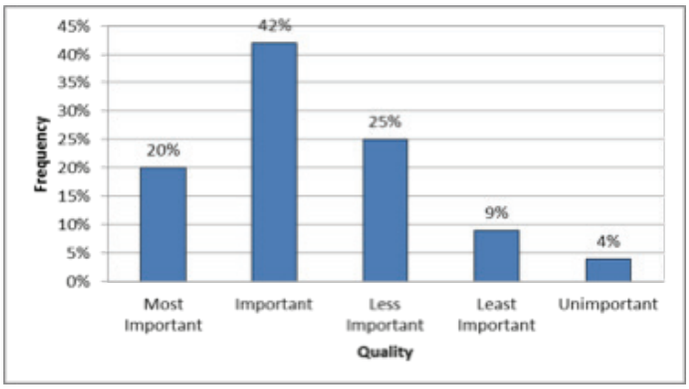

Fig. 3. Problem of management of construction quality due to subcontracting

Performance and Level of Satisfaction with Subcontracting

Respondents were asked to rate the performance of subcontractors on a scale ranging from 'very good', 'good', 'fair', 'bad', and 'very bad'. Respondents graded the performance of subcontractors as 'good' 42%, 'fair' 55%; and 'bad' 3%. None of the respondents regarded it as 'very good' or 'very bad' (see Fig. 4 and Fig. 5). Interviews revealed that subcontracting is not an ideal arrangement when it affects the quality of work negatively. Respondents still consider subcontracting as a better arrangement than employing their own direct labor and the results of Kruskal Wallis test provided a value of 0.991 (significance < 0.05) confirm the consistency of the views of clients, consultants and contractors on the issue of the practice of subcontracting (Fig. 4). When asked if they were satisfied or dissatisfied with the current practice of subcontracting, 54% of the respondents indicated that they were satisfied with the existing subcontracting system, while 26% were 'not satisfied' and 20% had no comments (see Fig. 6). Nonetheless, interviews indicate that current subcontracting practices need improvement. Despite concerns, respondents generally feel that subcontracting will continue to flourish as long as it provides flexibility and other benefits to construction firms.

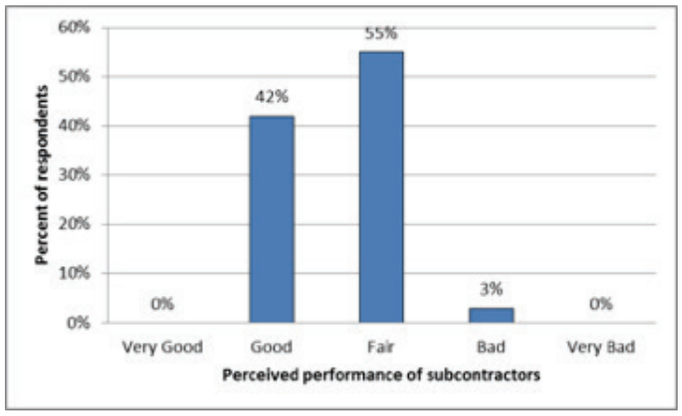

Fig. 4. Respondents views of subcontractor performance

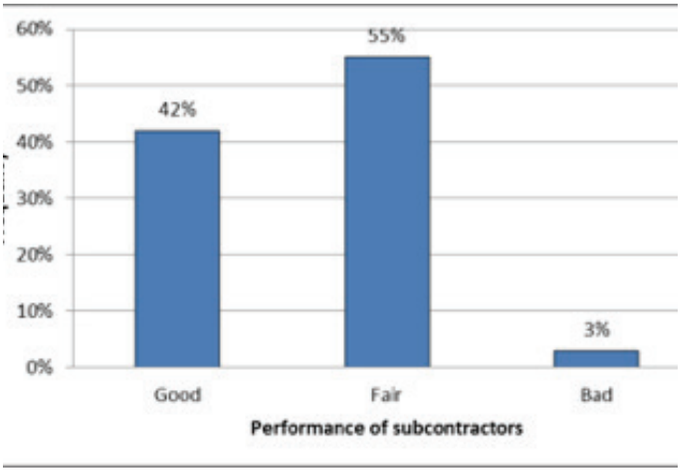

Fig. 5. Performance of subcontractors

Ways to Improve the Quality of Construction

Respondents were asked to show their level of agreement that the 16 subcontracting

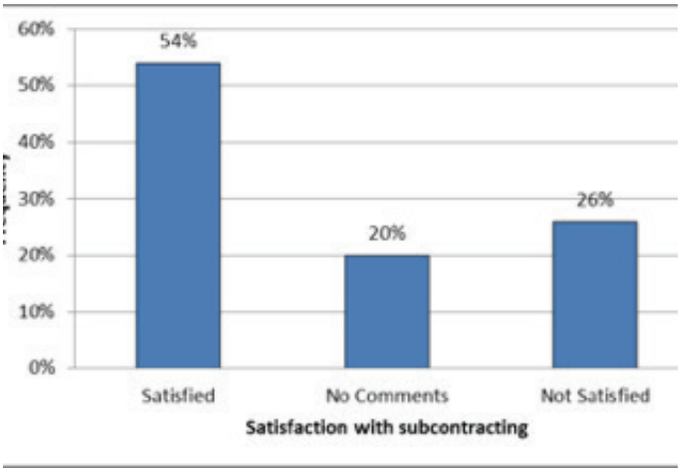

Fig. 6. Satisfaction with subcontracting

practices improve construction quality. Responses were obtained on a five-point Likert-scale with options ranging from 'strongly agree' ('1') to 'strongly disagree' ('5'). Of the various measures to improve construction quality, respondents (N = 69) expressed the strongest agreement that quality would improve with increased tender price (mean = 1.68), followed by training of supervisory staff (mean = 1.70), reducing the number of layers of subcontractors (mean = 1.78), and the technical training of construction workers (mean = 1.97). The results show that the utilization of more direct labor (mean = 3.22) to improve construction quality received the lowest priority among the choices i.e. respondents do not favor the utilization of direct labor by prime contractors as an alternative to subcontracting. They stated that prime contractors generally employ direct labor in the basic trades e.g. concreters, carpenters and bricklayers. Respondents revealed that direct labor was employed to undertake complicated assignments that were not adequately defined in a subcontract.

Discussion

A major finding of this research is that there is no prequalification registration or system in place for the performance evaluation of subcontractors which will continue to affect construction quality. This result is consistent with the findings of Loh and Ofori (2000) who found that registered subcontractors were perceived as performing better than non-registered ones. With an increasing awareness of the problems caused by substandard workmanship by subcontractors, countries such as Singapore have introduced a centralized subcontractor registration system of trade subcontractors as a means to eliminate incompetent subcontractors from being invited to submit bids. The list is particularly useful in helping to identify a suitable subcontractor for specific projects. In Hong Kong, a voluntary subcontractor registration scheme has been in place since 2003, which is comprised of a primary registry with relatively simple and accommodating entry requirements (HKSAR 2003). Palaneeswaran et al. (1999) reveal that a centralized subcontractor performance appraisal system would not only assist prime contractors in appraising subcontractor performance during and after the completion of a project but would also serve as a common basis for recording, comparing, sharing and benchmarking subcontractor performance.

Another finding of this research is the general lack of the use of standard form subcontract agreements. To safeguard the interests of subcontractors and prime contractors, it is wise to utilize a standard form of subcontract. In Malaysia, the Construction Industry Development Board (CIDB) has published the Model Terms of Construction Contract for subcontract work. The publication is consistent with the strategic recommendations of the Construction Industry Master Plan (CIMP 2006-2015) which promotes professionalism in the construction industry (CICC 2007). Overly simple contracts and oral contracts lead to disputes and work suspensions, as they frequently do not address many of the issues that may arise during the execution of construction work.

The widespread use of multi-tier subcontracting was found to be a common construction practice. In Hong Kong, it was contended that multi-tier subcontracting causes inefficient communications and the lower-tier subcontractors are not fully aware of the clients' requirements and this contributes to substandard work (Wong and So 2004). Prime contractors and subcontractors should evaluate their relative roles and responsibilities to ensure that their roles are essential, reinforcing and contributory.

In Pakistan, the lack of infrastructure for technical and professional training of subcontractors contributes to poor quality workmanship. Workers generally acquire their work skills through on-the-job training with guidance from experienced supervisors/ workers. Training programs for construction

workers have been made available in Hong Kong through the Construction Industry Training Authority (CITA), which was established in 1975. The programs offered by CITA and other qualified institutes (e.g. the Vocational Training Council through its Institutes for Vocational Education) are key means through which workers register as Registered Construction Workers under the Construction Workers Registration Ordinance (HKSAR 2005). Apart from the training of workers, manager training is essential to exercise better control, achieve higher degrees of integration of activities and meet the full technical requirements of the projects.

Concluding Remarks

There is a general sense that poor construction quality exists in the construction industry and that it is partially attributable to the current subcontracting practices. To improve the existing subcontracting practices, collaborative efforts of all the stakeholders are essential. Within the overall context of subcontracting in the construction industry, the following conclusions are drawn from this study:

1. There is widespread use of subcontracting (and even multi-tier subcontracting) in the construction industry. This practice affects communications between the clients and prime contractors and ultimately influences the prompt dissemination of information to the subcontractors.

2. Subcontracting practices in the construction industry are not being regulated through any regulatory authority or statutory body. There are no established criteria for the selection of subcontractors and the present registration system focuses on prime contractors.

3. There is no common practice of using standard form of contracts between prime contractors and subcontractors and the terms of the contract are primarily determined by the prime contractors, resulting in the potential exploitation of subcontractors. Subcontractors are exploited to a certain degree as the prime contractors hold the power not to award work to the subcontractor in the projects to follow.

4. Multi-tier subcontracting makes quality management more difficult because of profit absorption at the different levels. With additional subcontractors involved and the lack of infrastructure for the professional and technical training of subcontractors, efficient operations are compromised.

5. Approximately half of the parties involved in the construction process are generally satisfied with subcontracting and they feel strongly opposed to the use of direct labor by prime contractors. It is concluded that the use of direct labor is not very practical because of the high degree of uncertainties, fluctuations in construction workload and higher administrative overhead costs associated with direct hire arrangements.

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Causes Of Time Overruns And Possible Remedies For Mega Petrochemical Projects In Saudi Arabia

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Because of major investment, owners have been increasingly recognizing the need for timely completion of petrochemical projects in Saudi Arabia. However, numerous unexpected problems and changes during engineering and construction phases has lead to time and cost overruns. The prime objective of this paper is to identify the major causes of time overruns in Saudi Arabian petrochemical industry and their relative importance as perceived by different participant groups and to suggest remedies to minimize their affects for petrochemical projects. A questionnaire survey based upon one hundred ten predetermined delaying factors, grouped into ten major factor categories, was conducted during April -June 2009 from a randomly selected sample of owners, EPCm and EPC contractors working on different petrochemical projects in Saudi Arabia. They were requested to indicate their degree of importance. The importance of delaying factors and categories were measured and ranked for different participant groups. The results suggest a strong consistency in perception between owners, EPCm and EPC contractors for the ten major factor categories. However, there was substantial disagreement between owners, EPCm and EPC contractors in respect to the ranking of individual factors. This indicates a difference in priorities that each participant group perceives.

INTRODUCTION

In September 1976, Kingdom of Saudi Arabia decided to set up hydrocarbon and mineral base industries in the country. The aim was to diversify the Kingdom's sources of income from oil, utilizing natural gas as raw material to manufacture petrochemicals, which was

previously burned at the wellheads. Two new industrial cities Jubail and Yanbu along with infrastructure and other associated facilities were built on the east and west coasts and the petrochemical industry that has expanded exponentially during the last three decades is based in these cities[1,2].

Petrochemical is a highly advanced industry and requires major capital investment. One of the prime objectives of owners is to complete the project on time. "Completion period" often serves as a benchmark for assessing the performance of a project and the efficiency of the project organization [3]. Ashley et al. [4], Pinto and Slevin [5], and Chan and Kumaraswamy [6] found that a project is usually regarded as "successful" if it is completed on time, within budget and to the specified quality standards. Moreover, Rwelamila and Hall found that timely completion of project was frequently seen as major criterion of project success [7]. However, severe criticisms of the industry arise if projects take longer than planned [8, 9, 10,].

Generally, project delays occur during engineering and construction phases where unforeseen factors along with co-operation and co-ordination between many separate parties such as owners, contractors, manufacturers and suppliers are involved [11, 12]. Research on delays and the causes for construction projects have been reported by Wood [13], Mobbs [14], NEDO [15, 16], Naoum [17], Fereig and Qaddumi [18], Arditi et al. [19], Okpala and Aniekwe [20], Mainsfield et al. [21], Assaf et al. [22], Kaming et al. [23], Chalabi and Camp [24] and Chan and Kumaraswamy [25, 26, 27]. Most of them stressed that adequate construction planning at early stages of the project is important to limit time and cost overruns. Russell and Skibniewski [28] concluded that decision criteria in Contractor's selection plays an important role in the delivery of construction project.

Chan and Kumaraswamy [3] and many other researchers agree that project delays are a common issue in the international construction industry of today and the same has been observed in Saudi petrochemical industry as well. Therefore, in order to understand the causes of time overruns in Saudi petrochemical projects it was considered worthwhile conducting a survey having the following objectives.

1. To identify the principal causes of time overruns and their relative importance.
2. To study the difference in the perceptions of the major participants of the industry namely, owners, engineering procurement and construction management (EPCm) contractors, and engineering procurement and construction (EPC) contractors as to the factors causing time overruns.
3. To test for any agreement on the time overruns factors and factor categories between any two groups of respondents.

RESEARCH METHODOLOGY

This study was undertaken into two phases. As part of a research program in 2003 principal author [27] conducted literature review and determined one hundred ten delaying factors (causes of time overruns) influencing construction projects in Saudi Arabia that were validated by a number of case studies. In the second phase, these delaying factors were grouped into ten major factor categories namely (1) manpower, (2) engineering, (3) owner's organization, (4) contractor's organization, (5) contractual relationship, (6) project planning and control, (7) variations, (8) project environment, (9) finance and (10) materials and procurement; and a questionnaire was developed. The authors adopted a scale of 1 to 5 to assess the effect of each delaying factor as follows.

- Extremely significant – 5

- Very significant – 4
- Moderately significant – 3
- Slightly significant – 2
- Not significant – 1

The questionnaire along with a covering letter briefly stating the objectives of survey was sent by e-mail to the selected respondents, later the responses were expedited by phone and e-mails. The respondents were requested to rank the individual delaying factors in order of importance based upon their local experiences in Saudi Arabia.

The questionnaire was sent to one hundred and eighteen (118) randomly selected owners, EPCm and EPC contractor's representatives working on different petrochemical projects in Saudi Arabia. Eighty six (86) completed questionnaires were returned, six (6) of them were found incomplete and therefore were excluded from the survey, finally yielding a response rate of 68%, which includes 24 responses from EPC contractors and 28 responses each from owners and EPCm contractors.

METHODS ADOPTED FOR DATA ANALYSIS

Assaf et al. [22] and Chan and Kumaraswamy [3] adopted the "mean score" method to determine the relative importance of the causes of time overruns in Saudi Arabia and Hong Kong respectively. Authors adopted the same technique for the analysis of data collected from the current questionnaire survey. A five-point scale as described earlier was used to calculate mean score for each factor/factor category and accordingly ranks were assigned in descending order. The assigned ranking made it possible to cross compare the relative importance of the factors/factor categories as perceived by each participant group. The mean score for each factor / factor category was calculated from the following equation.

$$\mathbf{MS = \Sigma\ (f*s)/n} \text{ ---------- (1)}$$

where *"f"* is frequency of respondents to each rating (i.e. 1-5) for each factor/factor category, and *"s"* is score given to each factor/factor category by the respondents and ranges from 1 to 5 where "1" is not significant and "5" is extremely significant; and *"N"* is the total number of responses for the concerning factor.

Spearman rank correlation coefficient analysis is commonly used to measure correlation between two sets of ranking. The rank correlation coefficient (r_s) ranges from -1 to +1. A correlation coefficient of +1 suggest a perfect linear correlation whereas a value -1 means negative correlation which suggest that high ranking on one is associated with low ranking on the other. In case of zero value, no linear association exists [30]. Kometa et al. [31], Chan, and Kumaraswamy [3] used Spearman rank correlation to test the agreement in ranking. The authors used the correlation analysis to test the agreement in ranking for individual factors and factor categories between various groups. Wessa, P. on line statistics software [32] was used to analyze the data. Authors used *"t-test"* at a 95% confidence interval to test the following H_1 hypothesis for fifteen most significant delay factors and ten major factor categories. H_0 denotes the null hypothesis and is accepted if the observed *"t"* value is less than standard critical *"t"* value for (*n-2*) degree of freedom.

Fifteen most significant delay factors

H1: The two groups of participants in the petrochemical industry of Saudi Arabia

agree on the ranking of importance of delay factors.

H_0: The otherwise

Ten major delay factor categories

H1: The two groups of participants in the petrochemical industry of Saudi Arabia

agree on the ranking of importance of delay factor categories.

H_0: The otherwise

PRESENTATION OF SURVEY RESULTS

Experience is an important factor of ranking exercise. The experience of the participants who took part in this questionnaire survey ranges from 8-40 years. Therefore, it is considered that the information provided by them regarding the importance of causes of time overruns in Saudi petrochemical projects are reasonably reliable.

Mean scores (MS) and the ranks of the top twenty five significant factors selected from one hundred ten predetermined factors causing time overruns for Saudi petrochemical projects as postulated by the owners, EPCm and EPC contractors are presented in Table 1-3.

Table 4 shows the fifteen most significant delay factors as perceived by the owners, EPCm and EPC contractors calculated through the following "weighted average" *(WA)* equation utilizing mean scores (MS) of each individual factor of the participant group from Table1-3. In this equation *"n/N"* represents the sum of

$$\mathbf{WA = \Sigma\ [(n/N)*MS]} \text{ ---------- (2)}$$

products of the proportion of questionnaires received from each participant group where n = 28 for owners and EPCm contractors group and 24 for EPC contractor group and N = 80.

Table 5 summarizes the mean scores and ranks for the ten-delay factor categories as postulated by owners, EPCm and EPC contractor groups in Saudi petrochemical industry. The mean score of each factor category was taken as the "mean" of the individual factors within the same category. The "weighted average" (*WA*) for each factor category was obtained utilizing equation 2 above.

One of the objectives of this study was to test agreement, if any, on the time overrun factors and factor categories between any two groups of respondents. Table 6 presents the results of Spearman's rank correlation coefficient and t-values for the fifteen most significant delay factors as postulated by different participant groups. The analysis indicates that observed t-values for all three groups (while comparing them with each other) for any agreement are less than critical t-values at 95 % confidence interval, which suggest a significant disagreement between all three groups. Hence, the null hypothesis H_0 for all three-participant groups is accepted.

Table 7 presents the results of Spearman's rank correlation coefficient and t-values for the ten major factor categories contributing to delays in Saudi petrochemical projects as perceived by different participant groups. The analysis shows that observed t-values for all three groups (while comparing them with each other) for any agreement are higher than critical t-values at 95% confidence interval, which suggest a significant agreement between all three groups. Hence, the hypothesis H_1 for all three-participant groups is accepted.

Delaying factors	Mean Score (MS)	Rank (R)
Non – performance of contractor or its sub-contractors	4.286	1
Poor organization of contractors	4.179	2
Late appointment of skilled personnel by owner for owner Project Management Team	4.107	3
Poor project Planning	4.071*	4
Inaccurate estimation of project durations by owners or unrealistic contract durations imposed by owner	4.071	5
Poor quality of project management by owner's project management team	4.036	6
Shortage of skilled labor	4.000	7
Slow or late delivery of material by manufacturers	3.964	8
Frequent changes in scope of work during engineering by the owners	3.929	9
Poor/unsuitable leadership of engineering design team from owner's organization	3.893*	
Organization of owner's project team	3.893	11
Lack of co-ordination between various parties working on the project	3.893	12
Mistakes and discrepancies in design documents (e.g. specifications, drawings, BOQ, project cost etc.) during engineering	3.857	13
Ineffective decision making procedure by owners	3.821*	14
Poor co-ordination of project inter phase by owner's or integrated project management team	3.821	15
Late selection of consultants or engineering contractor by owner	3.821	16
Inaccurate estimation of time required to import a material	3.786	17
Slowness of owner's decision making process	3.750*	18
Poor project implementation and management by owner's or integrated project management team	3.750	19
Design errors by designers due to unfamiliarity with local conditions and environment	3.750	20
Project priorities identified by owner	3.750	21
Design changes during construction	3.714	22
Lack of communication among integrated engineering design team	3.679*	23
Lack of trained professionals and management support to model the construction operation.	3.679	24
Shortage of material in local market	3.679	25

*Equal mean scores (MS) of individual factors firstly ranked according to the number of respondents scoring 5 and secondly 4 or more

Table 1. Owner's responses to the ranking of top 25 significant factors causing time overruns in petrochemical projects (N=28)

Delaying factors	Mean Score (MS)	Rank (R)
Slow or late delivery of material by manufacturers	4.286	1
Design changes during construction	4.250	2
Non – performance of contractor or its sub-contractors	4.143	3
Frequent changes in scope of work during engineering by the owners	4.000*	4
Poor quality of project management by owner's project management team	4.000	5
Excessive bureaucracy (paper work too many permits, overlapping authority) in owner's organization	4.000	6
Shortage of material in local market	3.964*	7
Poor co-ordination of project inter phase by owner's or integrated project management team	3.964	8
Slowness of owner's decision making process	3.893*	9
Poor communication between owner and contractors	3.893	10
Inaccurate estimation of time required to import a material	3.893	11
Lack of co-ordination between various parties working on the project	3.857	12
Poor project planning	3.821*	13
Organization of owner's project team	3.821	14
Allocation of project responsibility by owner	3.786*	15
Obtaining work permit to import manpower	3.786	16
Late release of permits by the government	3.786	17
Contract documents prepared on an incomplete engineering design	3.750*	18
Design errors by designers due to unfamiliarity with local conditions and environment	3.750	19
Poor/unsuitable leadership of engineering design team from owner's organization	3.750	20
Changes in type and specification of material during construction	3.750	21

Poor organization of contractors	3.750	22
Financial stability of owner	3.714*	23
Poor project implementation and management by owner's or integrated project management team	3.714	24
Unavailability of professional construction managers	3.714	25

*Equal mean scores (MS) of individual factors firstly ranked according to the number of respondents scoring 5 and secondly 4 or more

Table 2. EPCm Contractor's responses to the ranking of top 25 significant factors causing time overruns in petrochemical projects (N=28)

Delaying factors	Mean Score (MS)	Rank (R)
Shortage of material in local market	3.833*	2
Slow or late delivery of material by manufactures	3.833	3
Slowness of owner's decision making process	3.750	4
Lack of co-ordination between various parties working on the project	3.708	5
Shortage of skilled labor	3.667	6
Design changes during construction	3.625	7
Ineffective decision making procedure by owners	3.583*	8
Poor quality of project management by owner's project management team	3.583	9
Excessive bureaucracy (paper work too many permits, overlapping authority) in owner's organization	3.583	10
Uncooperative owner / his representative	3.542*	11
Inaccurate estimation of project duration by owners or unrealistic contract durations imposed by owner	3.542	12
Poor communication between owner and contractors	3.500*	13
Late release of permit by the government	3.500	14
Frequent changes in scope of work during engineering by the owners	3.458*	15
Poor organization of contractors	3.458	16
Design errors by designers due to unfamiliarity with local conditions and environment	3.417*	17
Organization of owner's project team	3.417	18
Conflict between owner and contractor	3.375*	19
Lack of trained professionals and management support to model the construction operation.	3.375	20
Unavailability of professional construction managers	3.375	21
Mistakes and discrepancies in design documents (e.g. specifications, drawings, BOQ, project cost etc.) during engineering	3.333*	22
Inaccurate estimation of time required to import a material	3.333	23
Unavailability of specialist sub - contractors	3.333	24
Poor /unsuitable leadership of engineering design team from owner's organization	3.292	25

*Equal mean scores (MS) of individual factors firstly ranked according to the number of respondents scoring 5 and secondly 4 or more

Table 3. Engineering Procurement & Construction (EPC) Contractor's responses to the ranking of top 25 significant factors causing time overruns in petrochemical projects (N=24)

Delaying Factor	Owner		EPCm Contractor		EPC Contractor		Weighted average	
	Mean Score (MS)	Rank (R)	Mean Score (MS)	Rank (R)	Mean Score (MS)	Rank (R)	Mean Score (MS)	Rank (R)
Non – performance of contractor or its sub-contractor	4.286	1	4.143	3	3.917	1	4.125	1
Slow or late delivery of material by manufacturers	3.964	7	4.286	1	3.833*	3	4.037	2
Poor quality of project management by owner's project management team	4.036	5	4.000*	5	3.583*	8	3.888	3
Design changes during construction	3.714	13	4.250	2	3.625	7	3.875	4
Shortage of material in local market	3.679	14	3.964	7	3.833	2	3.825*	5
Lack of co-ordination between various parties working on the project	3.893*	10	3.857	9	3.708	5	3.825	6

Frequent changes in scope of work during engineering by the owners	3.929	8	4.000	4	3.458*	12	3.813*	7
Poor organization of contractors	4.179	2	3.750	12	3.458	13	3.813	8
Slowness of owner's decision making process	3.750	12	3.893	8	3.750	4	3.800*	9
Shortage of skilled Labor	4.000	6	3.714	14	3.666	6	3.800	10
Inaccurate estimation of project duration by owners or unrealistic contract durations imposed by owners	4.071*	4	3.679	13	3.542	11	3.775	11
Organization of owner's project team	3.893	9	3.821*	11	3.417	14	3.725	12
Excessive bureaucracy (paper work too many permits, overlapping authority) in owner's organization	3.536	15	4.000*	6	3.583	10	3.713	13
Poor project planning	4.071	3	3.821	10	3.167	15	3.712	14
Affective decision making procedure by owners	3.821	11	3.679	15	3.583	9	3.700	15
*Equal mean scores (MS) of individual factors firstly ranked according to the number of respondents scoring 5 and secondly 4 or more								

Table 4. Mean scores and ranks for 15 most significant factors causing time overruns in petrochemical projects by all three groups of respondents

Delaying Factor	Owner		EPCm Contractor		EPC Contractor		Weighted average	
	Mean Score (MS)	Rank (R)	Mean Score (MS)	Rank (R)	Mean Score (MS)	Rank (R)	Mean Score (MS)	Rank (R)
Contractor's organization	3.807	1	3.736	2	3.408	1	3.662	1
Material & procurement	3.648	2	3.872	1	3.369	3	3.643	2
Connatural relationship	3.412	6	3.659	3	3.393	2	3.493	3
Engineering	3.615	3	3.505	6	3.137	4	3.433	4
Owner's organization	3.519	4	3.561	4	2.980	8	3.372	5
Project planning and Control	3.437	5	3.298	9	3.028	6	3.266	6
Variations	3.274	7	3.485	7	2.993	7	3.264	7
Manpower	2.940	8	3.509	5	3.125	5	3.195	8
Finance	2.902	9	3.360	8	2.747	9	3.016	9
Project Environment	2.469	10	2.850	10	2.452	10	2.597	10

*Equal mean scores (MS) of individual groups firstly ranked according to the number of respondents scoring 5 and secondly 4 or more.

Table 5. Mean scores and ranks for 10 major factor categories causing time overruns in petrochemical Projects by all three groups of respondents

Participants	Observed Spearman's rank correlation coefficient *rs*	Observed *t*- ratio	Critical *t* – value (0.05)	Probability *P*-value	Accept/Reject hypothesis
Owner and EPCm Contractors	- 0.139286	- 0.50714	1.7710	0.5962	Accept null hypothesis
Owner and EPC Contractors	- 0.210714	- 0.77719	1.7710	0.4296	Accept null hypothesis
EPCm and EPC Contractors	0.432143	1.72777	1.7710	0.1052*	Accept null hypothesis
*Probability is 90%, which suggest a weaker agreement between the parties.					

Table 6. Spearman rank order correlation test of agreement on the ranking of 15 most significant factors causing time overruns in petrochemical projects as perceived by three different groups of respondents

Participants	Observed Spearman's rank correlation coefficient *rs*	Observed *t*- ratio	Critical *t* – value (0.05)	Probability *P*-value	Accept/Reject hypothesis
Owner and EPCm Contractors	0.721212	2.944787	1.8600	0.0300	Accept hypothesis
Owner and EPC Contractors	0.733333	3.050851	1.8600	0.0272	Accept hypothesis
EPCm and EPC Contractors	0.781818	3.546580	1.8600	0.0188	Accept hypothesis

Table 7. Spearman rank order correlation test of agreement on the ranking of 10 major factor categories causing time overruns in petrochemical projects as perceived by three different groups of respondents

DISCUSSION OF SURVEY RESULTS

Due to taxation issues, generally EPC contracts in Saudi petrochemical industry contain two parts namely "Out of Kingdom (OOK) contract" and "In Kingdom (IK) contract. Though both (OOK & IK) contracts are awarded to two different legal entities, however these are linked with a bridging guarantee letter that obliges the OOK contractor to complete the IK part of contract as well. All engineering and procurement activities take place outside the Kingdom of Saudi Arabia under OOK contract, whereas construction activities are carried out inside the Kingdom of Saudi Arabia under IK contract. Generally, IK contractors are the subsidiaries of OOK contractors registered in Saudi Arabia as separate legal entities. Most of construction works are sub-contracted to local companies by IK contractors. The performance of IK contractor and its sub-contractors partially depends on timely delivery of engineering and material, which is the responsibility of OOK contractor. This is an area of concern where circular causation takes place and effect the delivery of project. EPCm contracts have the same pattern, where in IK contracts; contractors only manage / supervise the construction works carried out by another contractor without any major liability of liquidated damages. Though there was no consensus among the participants on delay factors, however it is interesting to note that EPC contractors ranked "nonperformance of contractor or its sub-contractor" whereas EPCm contractors ranked "slow or late delivery of materials by manufacturers" as very high. Being an affected party, owners agreed with EPC contractors. The finding leads to the conclusion that contractual obligations played a vital role while selecting relative importance of delay factors by the participants. Overall, participants ranked them as first and second delay factors respectively. "Shortage of material in the local market" ranked as the fifth significant delay factor by the participants should also be seen in the same context.

The participants ranked "Poor quality of project management by owner's project management team (PMT)" and "design changes during construction" as third and fourth significant delay factors respectively. Despite the nature of contracts, owner's PMT is fully involved in a project's decision-making process from engineering to procurement and construction phases. PMT reviews the documents against duty specifications and in principal approve them for the next phase. Again, this is an area of circular causation, which seamlessly leads to time and cost overruns. Owner's involvement in construction process certainly improves the quality but often generates "design changes". Bromilow [33], Hibbered [34], Chan and Kumaraswamy [3] found that design changes by owners during execution caused excessive delays to projects. Furthermore, Kumaraswamy and Chan [35] identified design changes as prime source of time overruns. Relative importance of these two factors in the present study conform the previous findings, where design changes by owners were seen as by-product of poor project management of owners. Although, the participants ranked "frequent changes in scope of work during engineering by the owners", "slowness of owner's decision making process", "inaccurate estimation of project duration by the owners", "organization of owner's project team", "excessive bureaucracy (paper work and overlapping authority etc.) in owner's organization" and "ineffective decision making procedure by owners" on seventh, ninth, eleventh, twelfth, thirteenth and fifteenth place respectively, however on theoretical grounds these are the attributes of owner's poor project management. It is worth noting that seven out of fifteen top most significant factors causing time overruns are the attributes of owner's poor project management. The finding strengthens the emerging postulation that owner's poor project management leads to design changes and is a prime cause of time overruns on Saudi petrochemical projects.

The participants ranked "Lack of co-ordination between various parties working on the project" as fifth significant delay factor. Theoretically, it attributes to a deficiency in planning and organization on the part of the contractor who is responsible for construction operation. In fact, delivery of project on schedule realistically reflects the contractor's ability to; organize and control the construction operation, optimally allocate resources and manage the flow of information between various parties working on project [16]. Okpala and Aniekwe postulated that ineffective management of site operations can be due to lack of experience and training at both technical and managerial level, inadequate technical and managerial manpower, as well as low level of productivity [20]. The survey analysis interestingly shows that participants ranked "poor organization of contractors", "shortage of skilled manpower" and "poor project planning" as eighth, tenth and fourteenth most significant delay factors respectively. Hence, it is obvious that relative importance of these factors is in line with the previous findings and these are the attributes of contractor's poor organization. Being an affected party, owners ranked it the second most significant delay factor.

Overall, it is observed that the fifteen most significant delay factors as perceived by participants are ranked from the contractual responsibilities point of view and strongly suggest that current style of owner's project management and contractor's organizations are the prime causes of time overruns.

CONCLUSION

The study identified the principal causes of time overruns and their relative importance, according to the experience based judgement and perception of owners, EPCm and EPC contractors in Saudi petrochemical projects through a questionnaire survey. One hundred ten factors causing time overruns were grouped into ten major factor categories and ranked for their relative importance. Mean score and weighted average techniques along with Spearman's rank correlation coefficient and t-values were used to analyze the data collected from the survey.

The survey results suggest a strong consistency in perception between owners, EPCm and EPC contractors for ten major factor categories. However, substantial disagreement is found between owners, EPCm and EPC contractors in respect to the ranking of individual factors. This indicates difference in priorities that each participant group maintains.

The results of this survey identified the "nonperformance of contractors or its sub-contractors", "slow or late delivery of material by manufacturers", "poor quality of project management by owner", "design changes by owners" and "contractor's poor organizations" as the most five significant causes of time overruns for Saudi petrochemical projects. Bearing in mind the findings, the following guidelines are suggested which might help to reduce the extent of project time overruns.

- ***Contractor's performance*:** The techniques of "Pre-qualification" and continuous screening through "performance evaluation" would be helpful in improving the contractor's performance. Performance evaluation should be shared with contractors, encouraging them to cope with shortcomings by upgrading the expertise of their technical and managerial personnel through suitable training programs.

- ***Material procurement*:** In addition to "Pre-qualification" and "performance evaluation" techniques, placing orders well in advance without post order design changes and continuous monitoring the situation in manufacturers shops would be helpful in obtaining material on time.
- ***Project management by owners*:** An effective decision making procedure without excessive bureaucracy and overlapping authority, along with suitable training

programs for technical and managerial personal of owners PMT would enhance the project management on owner's part.

- ***Design changes*:** The most effective method for minimizing design changes during execution is a thorough, complete and clearly defined project requirements from the owners. Sufficient time for basic engineering and its review by an independent party for the "completeness" before moving to EPC phase would be helpful in reducing design changes.
- ***Contractor's organizations*:** Optimal allocation of resources and maintaining experienced and trained manpower at both technical and managerial level would enhance the contractor's organization. Better project planning and coordination with optimal resources would improve the low level of productivity that would help in reducing the extent of project time overruns.

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Graphene—"A wonder material" that could change the World.

By Eng. Syed Mubashir H. Kirmani
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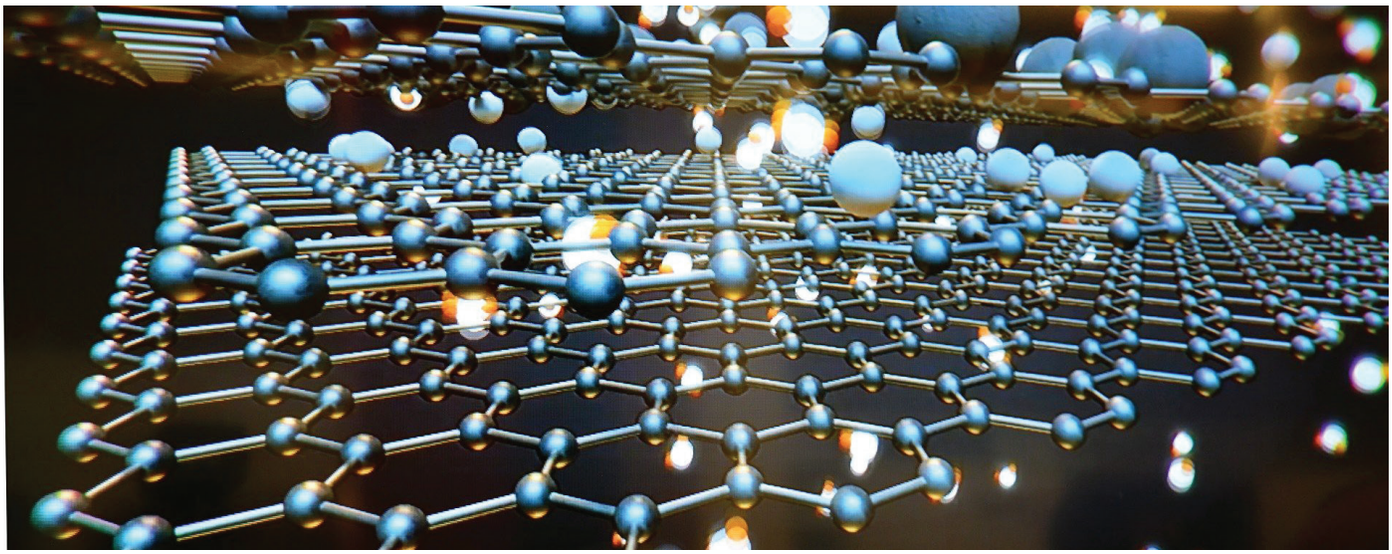


Abstract:

Graphene is an allotrope of Carbon, thinnest material known to man at one atom thick arranged in hexagonal lattice. Graphene is remarkable substance on it's own with a multitude of astonishing properties, incredibly strong—about 200 times stronger than steel and thinner than paper. It earned the title of " Wonder material" . This paper describes various properties of Graphene and it's potential use as engineering product the future of all technologies.

Introduction:

Technological advances drive the course of history. With the advent of "Electron microscope" Graphene was originally observed in 1962 ,but only studied while supported on metal surfaces(1). The material was later discovered isolated and characterized in 2004 by " Andre Gzim " and " Konstantin Novoselov" at the university of Manchester (2). High quality Graphene proved to be surprisingly easy to isolate ,making more research possible. This work resulted in the two wining of the Nobel prize in Physics in 2010 for ground breaking experiments regarding the two dimensional material the Graphene.

Graphene is the thinnest material known to man at one atom thick, and also incredibly strong about 200 times strong than Steel. On top of that Graphene is an excellent conductor of heat and electricity and has interesting light absorption abilities.

It is truly a material that could change the world with unlimited potential for integration in almost any industry.

History:

The theory of Graphene was first explored by P.R.Wallace in 1947 as a

Starting point for understanding the electronic

properties of 3D graphite. The emergent mass less Dirac equation (3) was first pointed out by Gordon Walter Semen off and David P. Divincenzo and Eugene. J. Mele (4).

Starting in 1970s single layer graphite were grown epitaxially on top of other material (5). This " epitaxial grapheme" consists of a single atom thick hexagonal lattice of carbon atoms as free standing Graphene.

In 2004 Andre Geim and Novoselov at university of Manchester extracted single atom thick crystallites from bulk graphite (2). They pulled Graphene layers from graphite and transferred them on to thin SiO2 on a Silicon wafer in a process called either micromechanical cleavage or the Scotch tape technique (6). The SiO2 electrically isolated the raphene and weakly interacted with it ,providing nearly charge neutral Graphene layers.

Geim and Novoselov received several awards for their pioneering research on Graphene, notably the 2010 Nobel prize in Physics.

In 2016 Brown university (Providence ,Rhode island united states) introduced a method for "crumpling " Graphene adding wrinkles to the material on a nanoscale. The crumpled Graphene became superhydrophobic, and when used as a battery electrode the material was shown to have as much as 400% increase in electro chemical current density (7).

Properties:

1) Specific surface area:

   Graphene has a theoretical specific surface area of 2630 squaremetes per gram. This is much larger than that reported to date for carbon black (Typically 900 square meters per gram) or for carbon nanotubes (CNTs), from 100 to 1000 square meters per gram and similar to activated carbon (8).

2) Mechanical & Physical :

   Graphene is the strongest material ever tested with an intrinsic tensile strength of 130 Gpa (19,000,000 Psi) and a Young's modulus (stiffness) of 1TPa (150.000.000Psi) (9)

   Graphene is very light . It weighs just 0.77 mg per square meter(About 0.001% of weight of 1 sq.meter of paper(10). Since it is a single 2D sheet, it has the highest surface area of all materials. When left to themselves Graphene sheet will stack and form graphite, which is the most stable 3D form of carbon under normal conditions.

   Graphene sheets are flexible and in fact Graphene is the most stretchable crystal. You can stretch it up to 20% of it's initial size without breaking it. Graphene is also highly impermeable and even helium atoms can not pass through it.

3) Chemical :

   Graphene is only form of Carbon (or solid material) in which every atom is avaialable for chemical reaction from two sides(Due to the 2D structure). Atoms at the edge of Graphene sheet have special chemical reactivity .Graphene has the highest ratio of edge atoms of any allotrope. The onset temperature of reaction between the basal plane of single layer graphene and oxygen is below 260 degree celcius. Graphene burns at very low temperature (e.g: 350 degree C). Graphene is commonly modified with oxygen and Nitrogen containing functional groups and analyzed by infra red spectroscopy and x-ray photo electron spectroscopy.

   In 2013, Stanford university physicists reported that single-layer graphene is a hundred times more chemically reactive than thicker sheets (11).

4) Electronic:

One of the most useful properties of Graphene is that it is

a zero-overlap semimetal (with both holes and electrons as charge carriers) with every high electrical conductivity. Carbon atoms have 6 electrons, 2 in the inner shell and 4 in the outer shell. Graphene is a zero gap semi conductor, because it's

conduction and valence met the Dirac points.

5) Permittivity:

Graphene's permittivity varies with frequency. At frequency near DC it is near 6.9 (12). Over a range from microwave to millimeter wave frequencies it is roughly 3.3 (13). This permittivity combined with the ability to form both conductors and insulators, means that theoretically compact capacitors made of graphene could store large amount of electrical energy.

6) Optical:

Graphene's unique optical properties produce an unexpectedly high opacity for an atomic mono layer in vacuum , absorbing about 2.3% of red light (14)

7) Thermal Conductivity:

Thermal conductivity of Graphene is an area of research

which has attracted attention of the scientists because of the potential for thermal management applications. Early measurement of thermal conductivity of suspended graphene reported an exceptionally large thermal conductivity of approx.. 5300 w/m/k (15) compared with thermal conductivity of Pyrolic graphite of approx..2000 w/m/k at room temperature. However it needs further investigation and confirmation.

Potential applications:

Having so remarkable properties, Graphene has inspired scientists to think of a wide range of uses for the material in wide range of field as consumer tech. and environmental science. A few potential applications are as following:

1) Solar cell/ Photovoltaics:

Graphene is both highly conductive and transparent. As such it has great potential as a material in solae cell. Typically , solar cells use silicon which produce a charge when a photon hits the materials, knocking loose a free electron. Silicon only releases one electron per photon that hits it. Research has indicated that graphene can release multiple electrons for each photon that hits it. As a result graphene could be better at converting solar energy. Before long , cheaper, more powerful graphene cells could produce a massive surge in renewable energy. Graphene's photovoltaic properties also mean that it could be used to develop better sensors for devices as a camera.

2) Semiconductors:

Due to it's high conductivity graphene could be used in semiconductors to greatly increase the speed at which information travels. Recently conducted tests demonstrated that semi-conductive polymers conduct electricity much faster when placed atop a layer of graphene than a layer of Silicon. This holds true even if polymer is thicker.

3) Water filtration:

Graphene's tight atomic bonds make it impermeable for nearly all gases and liquids. Strangely, water molecules are an exception. Because water can evaporate through graphene while most other gases and liquids can not. Graphene could be an exceptional tool for filtration. Researchers at the university of Manchester tested graphene's permeability with alcohol and were able distill very strong sample

of spirit, as only the water in the sample was able to pass through the graphene.

Graphene could also be immensely helpful in purifying water from toxins. In a study published by the Royal Society of chemistry, researchers showed that oxidized graphene could even pull radioactive materials such as Uranium and Plutonium present in water ,leaving liquid free from contaminations. The implication of this study are massive, some of the biggest environmental hazards in history, including nuclear waste and chemical run off, could be cleansed from water sources ---thanks to Graphene.

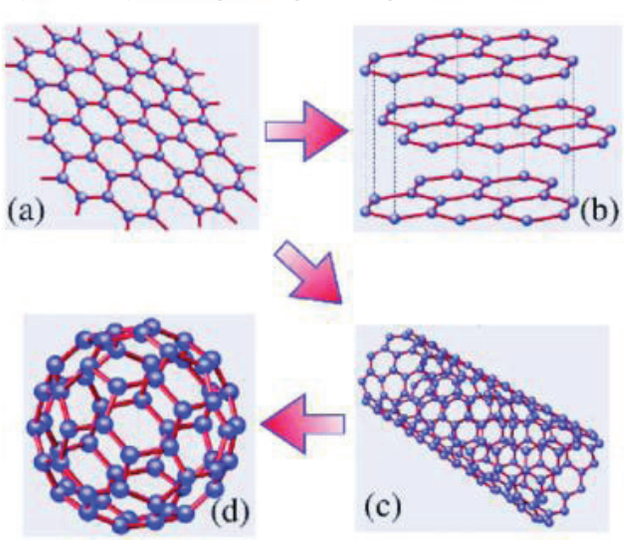
4) Super conductivity :

Scientists at Cambridge demonstrated that Graphene can act as a superconductor (A material with no electrical resistance)when paired with praseodymium cerium copper oxide. Researches at MIT discovered another astounding property that it can apparently function as a super conductor alone in the right configuration.

1) Other potential applications:

Since the 2010 Nobel prize in Physics went to Andre Geim and Konstantin Novoselo who first isolated Graphene in 2004, Graphene is getting lot of attention as it can be combined with other elements(including gases & metal) to produce different materials with various superior properties. It's possible application is already verified which include:

- Batteries
- Transister
- Computer chips
- Energy generation
- Super capacitor
- DNA sequencing
- Water Filter
- Antennas
- Touch Screens(For LCD or OLED displays)
- Solar cells



Graphene –CNTs Buckyballs-image

Conclusion:

Graphene is a new " super material ",one atom thick layer of Carbon (Carbon atom has a diameter of about 0.33 nanometer.there are about 3 million layers of graphene in 1 mm of graphite),Thinnner than paper, stronger than steel,harder than diamond yet more elactic than rubber, lighter than aluminium.

Graphene possesses amazing characteristics as following:

- It's high electron mobility is 10 times faster than Silicon.
- It's electrical conductivity is 13 times better than copper.
- It absorbs 2.3% of reflecting light.
- It is impervious so that even smallest atom(Helium) can not pass through a defect-free monolayer graphene sheet.
- It's high surface area of 2630 sq.meter

per gram means that with less than 3 gram, an entire Soccer field could be covered.

- It is 200 times stronger than steel.
- It is truly a material that could change the world with un limited potential for integration in almost any industry.
- Glossary :
- Dirac Points: Are the transition between the valence
- Band and conduction band. Dispersion relation of Graphene is calculated by using the tight binding model. Six Dirac points are observed which any two of them K ,K' are inequvalent.
- The Valence band is the band of electron orbitals that electron can jump out of moving into the conduction band when excited.
- Conduction Band: Is the band of elrctron orbitals that electron can jump into from the valence band when excited.
- Spintronics : Study of the intrinsic spin of the electron and it's associated magnetic moment, in addition to it's fundamental electronic charge in solid-state devices.

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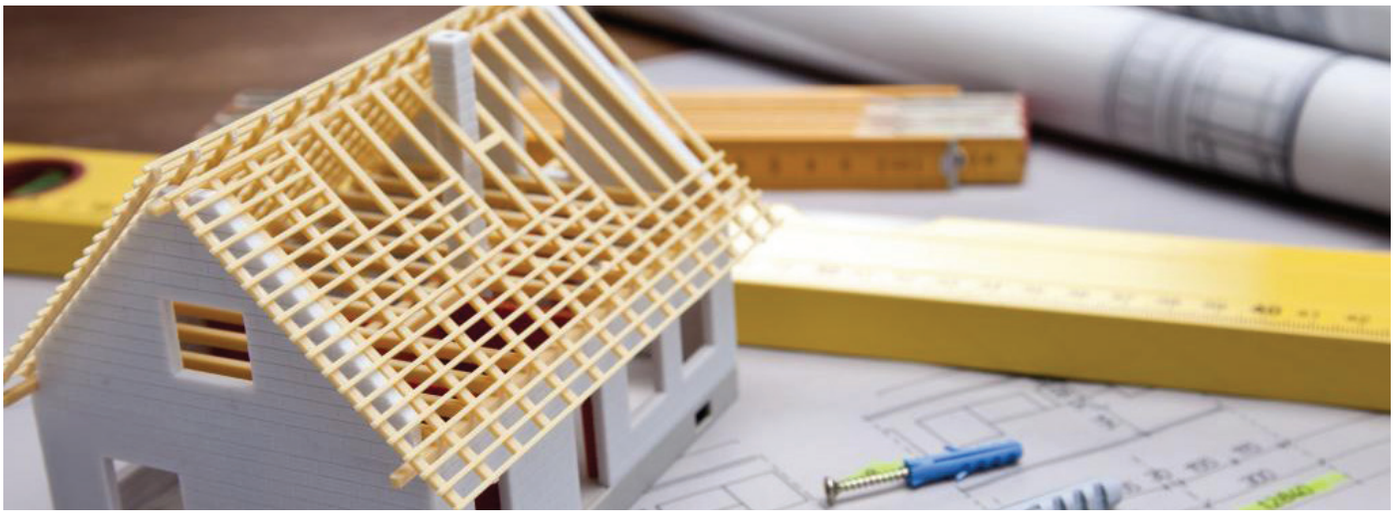
About Author:

Engineer Syed Mubashir Hussain Kirmani is a Civil engineer, having over 53 years of experience in diversified fields including Soil and foundation engineering ,structural engineering (Concrete and Steel) . motorways, public health engineering, water and waste water engineering and environmental engineering. Eng. Kirmani obtained B.Sc (Honors) degree with second position in applied mathematics , Astronomy and applied Physics in 1963 from University of Karachi, B.E (degree in Civil Eng.) in 1967 from N.E.D Eng. college Karachi, Post graduation in Engineering management in 1971 from IBA Karachi.

Eng. Kirmani has been serving in KSA since the last 43 years in a reputable Engineering organization as a chief engineer and Head of engineering management and achieved a high level of competence. He is fellow and active member of several Engineering Societies . Last year he received an award of excellence by the " Nature Conservancy USA" in recognition of his contribution to Land and Water conservation issues. Engr. Kirmani has been regularly contributing his articles to IEP-SAC Journal for the last 22 years. During the same period he made several presentation in Seminars on current engineering issues. He served IEP-SAC as general secretary for 8 years and subsequently as the chairman for four years. At present he has been assigned as the advisor to IEP-SCismaru, Alina; Dragoman, Mircea; Dinesuc, Adrian; Dragoman, Daniela; Stavrinidis,G; Konstantinidis, G(2013). "Microwave and Millimeterwave Electrical Permittivity of-Graphene Monolayer". arXiv: 1309.0990 .Bibcode: 2013arXiv1309. 0990C

Housing Sector Of Pakistan Issues & Solutions

By: Syed Abdul Majeed Shah



Abstract:

Housing is a big issue in Pakistan. This article discusses problems, solutions and all new development in pipeline in this sector.

Housing is fundamental & basic need after food & clothing. According to the 2017 census report, there are 19.2 million housing units in a country of which 38% one-room unit, 35% Kacha Units & 11% Semi Pakka. It is a shortage of 8.5 million houses and is growing 300,000 units every year.

It is the demand of 700,000 houses per year due to an increase in population & migration from rural to urban whereas supply is 400,000 units both in rural & urban areas. It is a big challenge to cover unmet demand.

The main ingredients of housing are land, infrastructure, finances, employment, available technology & materials and means of communications.

Real estate mafias exploited land matters and made it unreachable for common citizens, one has to spend lifesaving or end service gratuity on retirement to get a plot for building house same is the case for overseas Pakistanis they have to spare a big amount of their hard-earned money to buy a piece of land to live.

For an urban area, this is a matter of severe concern that mushroom of plots in the shape of housing societies & town is spread around all major cities. The dilemma is that these plots are de-marketed without the provision of basic infrastructure like water supply, drainage, electricity, gas & road works. In absence of these utilities, hundreds of thousand plots are lying empty on all sides of our cities. There is more than 200,000 plot lying vacant alone in Karachi for decades. This is a double edge loss on one hand money supposed to contribute in economic activities is getting blocked in nonproductive plots on other hand value able agriculture land is being swallowed by plots. Only in Multan 30% mango gardens are converted in housing societies and so on

the case of every city and big town. When no infrastructure is developed, people do not feel feasible to construct house so the plot remains vacant for years & years. The recent government has taken this issue to impose a ban on making new plans around cities for housing and announced to adopt the plan of vertical expansion not horizontal.

Lack of funds & non-availability of housing finance policy to support in house building is one major problem. A medium-range salary person cannot think of own house because there is neither a home mortgage plan nor loan facility from financial institutions. House building finance corporation (HBFC) established in 1984 so far disbursed 50 billion rupees. It is a small fraction compare to the huge need. Government spending on the housing sector has never been encouraging. Annual demand is for 300 billion rupees while budgetary allocation is merely one percent of demand.

The provision of sufficient funds is very important to develop infrastructure & basic services otherwise no major change will take place.

The current building technique is producing concrete jungles and impacting very adverse effects on the environment. This is one major cause of the rise in temperature. In the near past was a fatal heatwave in Karachi. Parks & open spaces are disappearing result is air pollution in all cities. Lahore, Karachi & Quetta rated very low in clean air among Asian cities.

Engineering institutions must start research in bringing environmentally friendly building materials. Our designers should seriously consider wall & roof insulation and to use double glazed windows for better temperature control & saving energy.

A correct land use plan is another important aspect of good housing. There has to be a strong regulatory framework that must protect all the sections of the population. Authorities should set a plot size ceiling of 500 square yards in cities.

The standard dwelling ratio is 400 persons per hectare while due to densification this ratio is in thousands for city centers because due to lack of transportation arrangements. Karachi is an only megacity of a region without a mass transit system. Generally, seven-member of habitants per house in urban areas and due to the joint family system in rural areas is over 12.

Floor area ratio (FAR) is an effective way to control the development of the residential area and non-residential lands, it is a decimal number and is derived by dividing the total area of a building by the total area of the parcel (building area/lot area). It is a comprehensive approach to achieve a standard population per hectare and to govern high and medium-rise buildings for a balanced plan.

Rural versus urban is a popular debate in this subject, both having pros & cons. Villages are totally ignored considering these are small populations which are not the correct approach, basic amenities should be in reach of all citizens both in rural & urban. Still, people will move from villages to towns and cities for better health, education & business opportunities. To cater to this shift new cities to be developed instead of swelling existing ones. A chain of medium-size cities easily can be developed on our coastal belts, in Chullistan, and in FATA by organizing industrial zones.

Another factor demanding attention is the high number of Kacha houses. In house count of 2017 census given in below table indicate that overall 35% of houses fall in this category. These are very risky because we are inactive seismic zone and hit by floods often. Authorities should facilitate safe house regulations and Engineers must bring a design to sustain disasters of earthquakes and floods.

Administrative Units		Total Housing Units	Housing Units by Number of Rooms				Housing Units by Type		
			One room	Two rooms	3 - 4 rooms	5 and more	Pacca	Semi Pacca	Kacha
Pakistan		**19211738**	**38.11**	**30.54**	**24.43**	**6.92**	**54.64**	**10.84**	**34.52**
	Rural	13180308	41.65	30.02	22.24	6.09	42.05	12.8	45.15
	Urban	6031430	30.38	31.68	29.23	8.72	82.14	6.56	11.30
Khyber Pakhtunkhwa		**2211236**	**27.71**	**34.5**	**29.11**	**8.68**	**56.15**	**5.58**	**38.26**
	Rural	1842488	28.60	34.73	28.48	8.19	53.01	5.87	41.11
	Urban	368748	23.28	33.35	32.27	11.1	71.85	4.13	24.02
F A T A		**341114**	**13.04**	**25.91**	**40.49**	**20.56**	**36.73**	**5.01**	**58.26**
	Rural	332506	12.89	25.76	40.69	20.66	36.81	5.03	58.16
	Urban	8608	18.89	31.81	32.59	16.72	33.75	3.97	62.28
Punjab		**10537127**	**31.97**	**33.54**	**27.12**	**7.36**	**62.00**	**8.03**	**29.96**
	Rural	7336193	33.78	34.00	25.71	6.51	52.21	8.62	39.16
	Urban	3200934	27.81	32.5	30.35	9.33	84.43	6.68	8.87
Sindh		**5022392**	**56.93**	**23.88**	**15.62**	**3.56**	**46.70**	**18.95**	**34.35**
	Rural	2850989	72.69	18.81	7.34	1.16	17.93	28.64	53.42
	Urban	2171403	36.25	30.54	26.5	6.71	84.46	6.21	9.32
Baluchistan		**971116**	**42.77**	**25.18**	**22.69**	**9.36**	**14.19**	**14.04**	**71.77**
	Rural	775954	46.66	24.24	20.48	8.62	8.41	14.16	77.44
	Urban	195162	27.32	28.9	31.47	12.29	37.18	13.58	49.23
Islamabad		**128753**	**16.01**	**29.47**	**38.38**	**16.14**	**87.97**	**5.64**	**6.39**
	Rural	42178	15.87	30.12	39.95	14.06	85.54	7.00	7.45
	Urban	86575	16.08	29.15	37.62	17.15	89.15	4.98	5.87

Solid waste management and sanitation are areas need more attention. Provision of clean water is also a big challenge it is irony that having rivers, good rainfall, the vast icy Himalayan range and long coastal belt with a potential of desalination still we have a shortage of water and risk is growing year by year.

Security concern has created gated communities, which is against free access and the principle of socialization. Security is a very basic right of humans towards authority this is why segregation of communities and happening of communal discomfort.

The current government announced the most ambitious plan to build 5 million houses at a rate of one million affordable houses per annum known as NPHP (Naya Pakistan Housing Program). This is a very attractive and wise scheme to improve the housing situation in Pakistan. The salient feature of this scheme is to give affordable houses to people. Unfortunately, no conclusive progress but a lot of legwork done in this regard. Due to political instability and worsening economic conditions are a big hurdle to materialize such an ambitious plan. A major step to utilized state-owned land lying vacant in major cities will ease the price of housing units. A fund of 25 billion Rupees allocated for this plan and another 35 billion rupees will generate from a new blue area in Islamabad F9 will add in this fund, with such steps expecting an investment

boom in the year 2020 towards housing.

The construction of houses will benefit forty different industries related to the construction business and will boost the country's economy. State land will be utilized to build 3-5 Marla houses preferably two-room apartments. The policy is in developing stage, initially announced for 7 districts in all provinces and eventually will spread across the whole country. The cost of a house will range from 1.5 million to 2.2 million & will be offered on installments to low-income families. Five percent discount for Overseas Pakistanis if applying their native district.

The government alone cannot solve the problem there are always private partners to contribute equally. Unfortunately, a major section from the private sector is behaving like mafia hiking prices, fill their banks, and snatch every penny from citizen seeking shelters.

In early 70's there were real state companies like Al-Azam, Hassan Associates, Maymar, Rukinuddin... in Karachi, Eden, Rafi builders.. in Lahore Khan builders in Multan & so in many cities later came DHA's, Bahria, LDA, CDA, MDA, QDA, PDA, FDA and many government departments like Fizaia, WAPDA, PHA & several cooperative societies entered in this field. Required to regularize such real estate players with an approach to carry the business in a healthy way, not with the strategy of manipulating price hike. They should make a reasonable profit and the government should help them in the provision of utilities and taking away legal hurdles in their way to perform better. This must be a win-win task.

Reduction in Cost of construction is a big challenge for engineers, we have all building material locally available and its production cost is not much only need to apply the latest techniques and by using competitive materials. Conventional construction costs range from Rs. 2200 to Rs. 3600 per square feet depending on the quality of material and finishes. The government can bring further ease in prices by adjusting huge taxes and by controlling the price-exploiting approach by owners of cement factory cartel.

It is need of the time to go for sustainable construction and adapt renewable energy schemes, rainwater harvesting, and environmentally friendly buildings. Let us hope and try with a joint public-private effort that every citizen should get suitable shelter in clean and green Pakistan.

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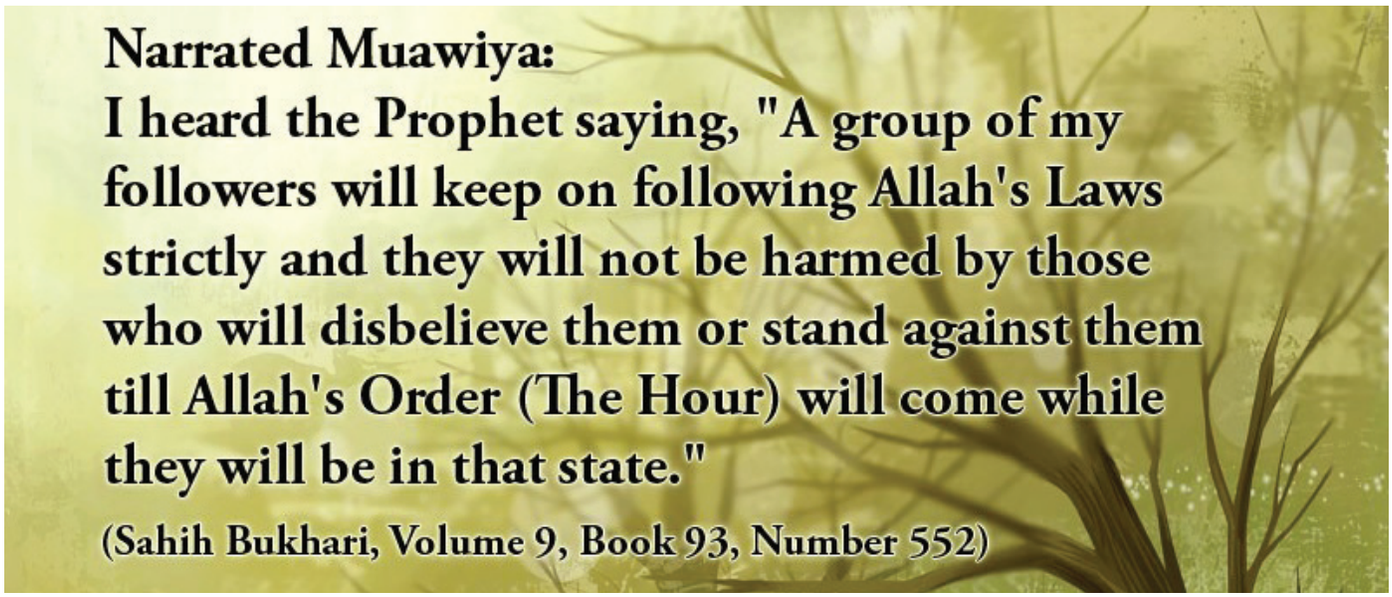

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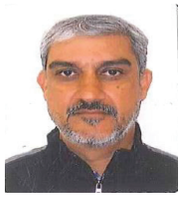

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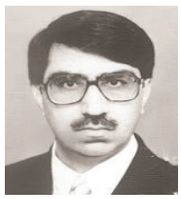

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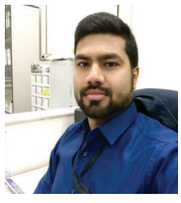

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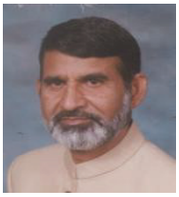

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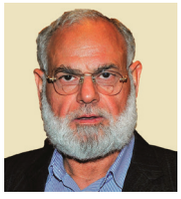

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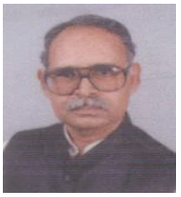

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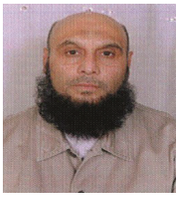

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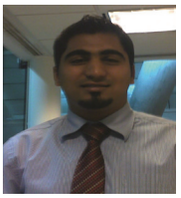

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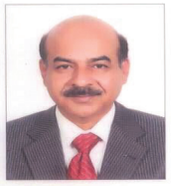

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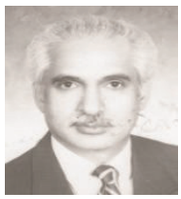

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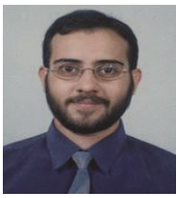

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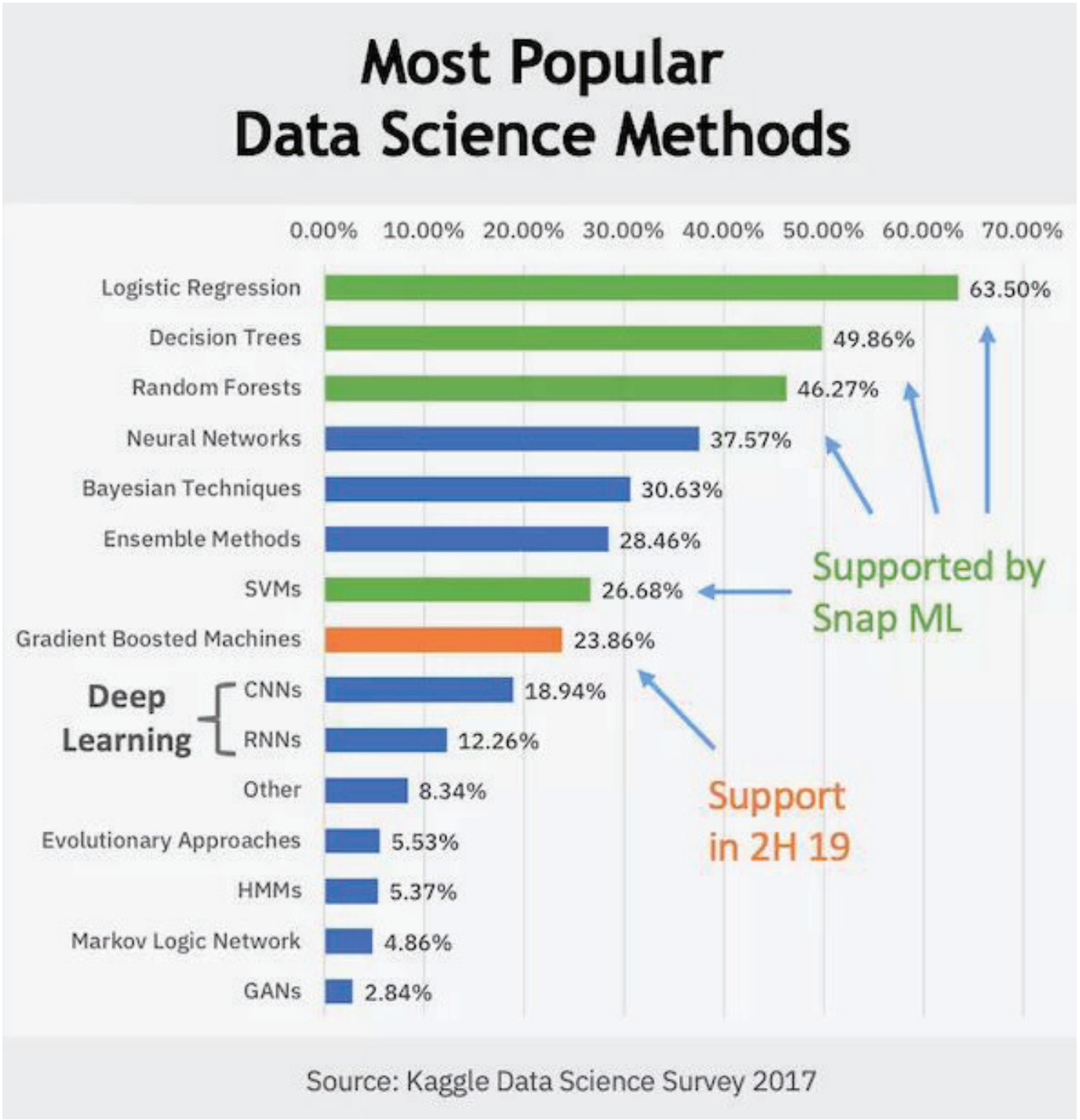

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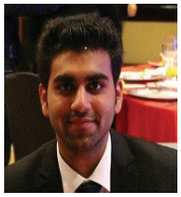

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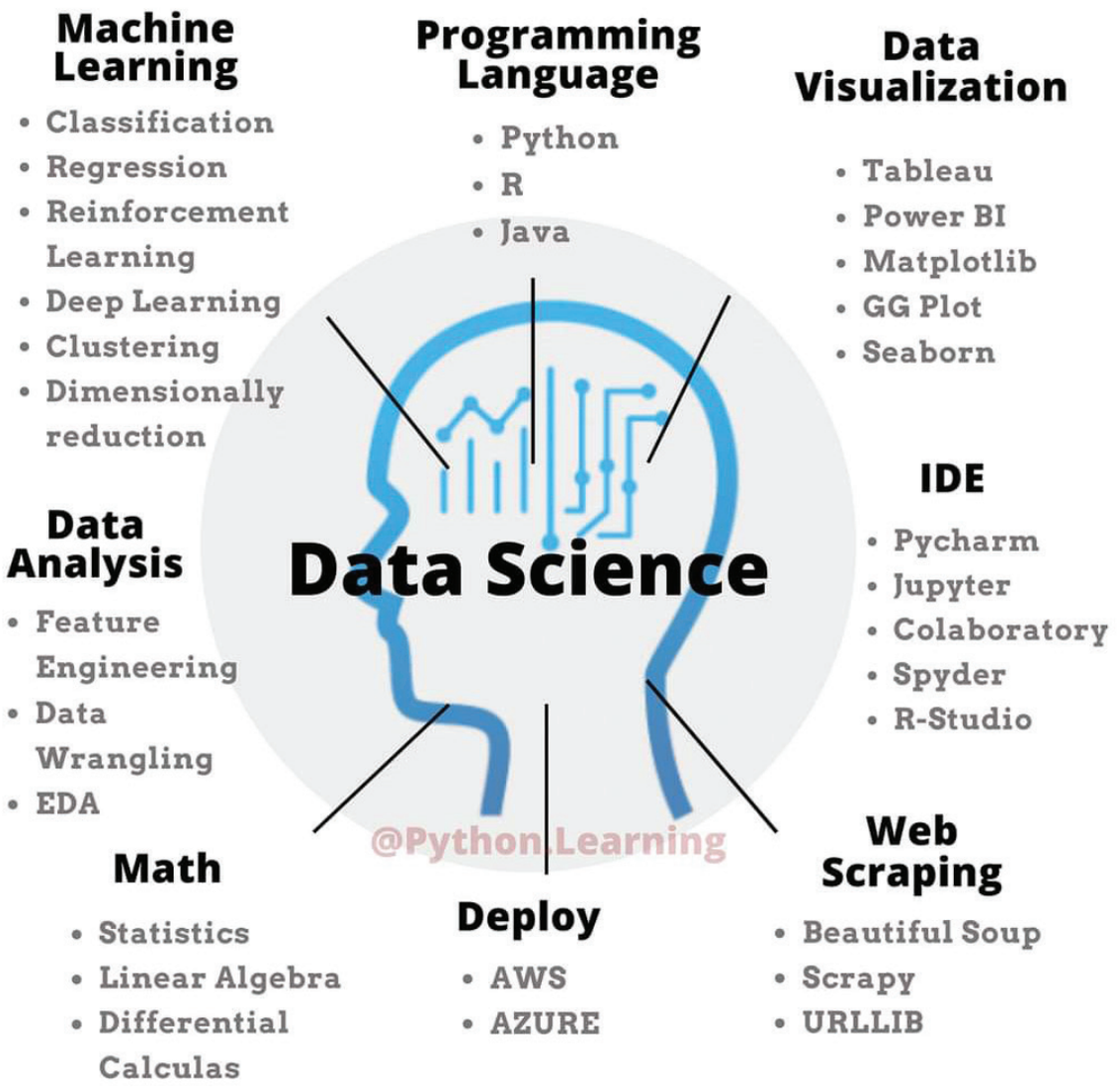

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Affix latest passport size photograph

1. Name in Full in Block Letters
2. Father's Name
3. NIC Number _____-_____-_____
4. Date of Birth _____-_____-_____
5. Permanent Address _____
6. Present / Postal Address _____
7. Telephone Number Office _____ Residence _____
   Mobile _____ Email _____
8. Basic Education _____
   Certificate/Degree Obtained _____ Year _____
   College / University _____
9. Engineering Education _____
   Degree Obtained _____ Year _____
   College / University _____
10. Post-Graduate Education _____
    Degree Obtained _____ Year _____
    College & University _____
11. Professional Training & _____
    Names of Organizations _____
    where Obtained _____
12. Membership (s) of other _____
    Professional Bodies, If Any _____
13. Practical Experience:

Sr. No.	ORGANIZATION	POSITION HELD	FROM	TO	Total Years
1.					
2.					
3.					
4.					
5.					

PLEASE ATTACH A COPY OF DETAILED BIO-DATA

14. Class of membership in which admission is sought

☐ Chartered Engineers ☐ Fellow ☐ Member ☐ Associate ☐ Affiliate ☐ Subscriber

Current Membership Number _____

PEC Registration Number _____

_____
Applicant's Signature

Proposer's Name (in block letters)	Signature	Date	Class of Membership

Seconder's Name (in block letters)			

Grade of Membership General Requirements	Transfer Fee Fellow to Chartered Engineer	Age (Minimum) Years	Entrance Fee	Transfer Fee Member to Fellow	Life Fee	Life Membership fee for Pakistan Engineer Readers Club	Annual Sub-Scription	Diploma / Certificate Fee	Total
	Rs.		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1. **Chartered Engineer** (A) Must be a Fellow of IEP (B) Must be holding, or must have held in the past, positions of high responsibility in the Engineering profession, for a minimum of 20 years.	--	45	--	--	2000/-	1500/-	--	200/-	3700/-
2. **Fellow** Must have all the qualifications of a Member and must be holding or must have held, in the past, position(s) of high responsibility in the Engineering profession for a minimum of 10 years. The applicant must have at least one technical paper (published in a journal of repute) to his credit. *Please enclose four hard copies and one soft copy of the technical paper for IEP's record.*		40	--	1000/-	2000/-	1500/-	--	150/-	4650/-
3. **Member** Must be in possession of: (A) Section A & B of IE (Pak), or (B) Degree in Engineering from any recognized University, or (C) Any other qualifications exempting the applicant from the above.		21	150/- 150/-	--	-- 1100/-	1500/- 1500/-	100/- --	100/- 100/-	1850/- 2850/-
4. **Affiliate** Must be an engineer, or a person, or a body of persons not belonging to other categories of corporate membership, whose interests are related to engineering profession by virtue of his/her occupation.		25			2000/-	1500/-	--	150/-	3650/-
5. **Subscriber** Any Business Enterprise, Company, Government Department, Registered Film or individual not eligible for Fellow, Membership, Affiliate Membership or students Membership who wishes to be so attached with IEP.		30 (For Individual)	--	--	5000/-	1500/-	--	150/-	6650/-

N.B.:
1. Proposer & Seconder must be Corporate Members of IEP.
2. This Application Form must be properly filled in and signed by the applicant, proposer and seconders & submitted to the H.Q. Office through the Local Centre concerned, together with attested copies of the Matriculation Certificate, Engineering Degree & CNIC Copy.
3. Please enclose a bank draft or crossed cheque in favor of IEP HQ for:
   a) Life Membership Fee
   b) Subscription for IEP Journal "The Pakistan Engineer"
   c) Fee for Life Membership of Readers Club to receive monthly Journal of IEP as and when published.
   d) Diploma Fee
4. When applying for fellowship of I.E.P. please quote current Membership Number.
5. Only Members of IEP are eligible for Fellow Membership.

If the applicant is not already a member of the Readers' Club.

Quaid Quotes

• The constitution of Pakistan has yet to be framed by the Pakistan Constituent Assembly. I do not know what the ultimate shape of this constitution is going to be, but I am sure that it will be of a democratic type, embodying the essential principle of Islam. Today, they are as applicable in actual life as they were 1,300 years ago. Islam and its idealism have taught us democracy. It has taught equality of man, justice and fairplay to everybody. We are the inheritors of these glorious traditions and are fully alive to our responsibilities and obligations as framers of the future constitution of Pakistan. In any case Pakistan is not going to be a theocratic State to be ruled by priests with a divine mission. We have many non-Muslims — Hindus, Christians, and Parsis — but they are all Pakistanis. They will enjoy the same rights and privileges as any other citizens and will play their rightful part in the affairs of Pakistan.

(Broadcast to the people of the United States of America on Pakistan, February 1948)

• You are free to go to your temples, you are free to go to your mosques or to any other place of worship in this State of Pakistan. You may belong to any religion or caste or creed. That has nothing to do with the business of the State.

(Presidential address to the first Constituent Assembly of Pakistan, Karachi, 11 August 1947)

• I have one underlying principle in mind: the principle of Muslim democracy. It is my belief that our salvation lies in following the golden rules of conduct set for us by our great lawgiver, the Prophet of Islam.

(In 1948, Address to Sibi Darbar)

• I cannot understand the logic of those who have been deliberately and mischievously propagating that the Constitution of Pakistan will not be based on Islamic Sharia. Islamic principles today are as much applicable to life as they were 1300 years ago.

(Address to Karachi Bar Association in January 25, 1948)