

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

إِنَّا كُلَّ شَيْءٍ خَلَقْنَاهُ بِقَدَرٍ

PAE

Pakistan Academy of Engineering

**Proceedings of the
24th Symposium of
The Pakistan Academy of Engineering**

**“Resilient Supply Chains for
Pakistan”**

**Held online on June 25, 2022
at The PAE Head Office, Karachi - Pakistan**

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1. Message from the President

My Dear Fellows and Readers,

السَّلَامُ عَلَيْكُمْ وَرَحْمَةُ اللَّهِ وَبَرَكَاتُهُ

With the great feeling of accomplishment and satisfaction, on behalf of The Pakistan Academy of Engineering (PAE), I present to you the proceedings of the 24th Symposium of The PAE on the topic of “**Resilient Supply Chains for Pakistan**”, held on June 25, 2022, at PAE Head Office, Karachi.

First I would like to thank

Prof. Engr. Syed Iqbal Hashmi Ex-Managing Director, SKF Pakistan, Karachi.

Prof. Professor & Chairman, Department of Computer & Information Sciences The State University of New York at Fredonia New York, USA,

Prof. Dr. Masood Mehmood Khan Fellow Higher Education Academy Perth, Australia

Secondly, my sincere thanks to the Pakistan Science Foundation (PSF), Principal Builders, and Ravian Maritime (Pvt) Ltd. for providing sponsorship support

Here I would also acknowledge the support of the Trustees of The Pakistan Academy of Engineering, Council members & Staff of The Pakistan Academy of Engineering (PAE) for their relentless support and assistance.

Finally, I hope that the readers will find the document useful and will gain knowledge and insight in the context of this complex and critical topic.

Very sincerely yours,



Chairman

Dr.-Ing. Jameel Ahmad Khan

President,

The Pakistan Academy of Engineering (PAE)

2. Programme of the 24th Symposium



The Pakistan Academy of Engineering

24th Symposium: "Resilient Supply Chains for Pakistan"

scheduled on June 25, 2022,

Broadcast: Online

Programme

- | | |
|---|-----------------------|
| 1. Recitation from the Holy Quran | 10 ⁰⁰ hrs. |
| 2. Welcome Address by the President,
The Pakistan Academy of Engineering,
<i>Dr. – Ing. Jameel Ahmad Khan</i> | 10 ⁰⁵ hrs. |
| PRESENTATIONS | |
| 3. "Strategies for Building Resilient Supply Chains for Pakistan"
<i>By Engr. Syed Iqbal Hashmi</i>
<i>Ex-Managing Director, SKF Pakistan,</i>
<i>Karachi</i> | 10 ¹⁰ hrs. |
| 4. "Review of the Resilient Supply Chains for Fossil Fuel Supplies in Pakistan"
<i>By Mr. Masroor Khan</i>
<i>Chairman, Oil & Gas Regulatory Authority,</i>
<i>Islamabad</i> | 10 ⁴⁵ hrs. |
| 5. "Review of the Resilient Supply Chains for the Cash Crops in Pakistan"
<i>By Dr. Abdul Ghafoor & Dr. Waseem Ahmad</i>
<i>Director IBMS, and Associate Professor,</i>
<i>University of Agriculture, Faisalabad</i> | 11 ³⁰ hrs. |
| 6. "Supply Chains for Large Scale Engineering Industries in Pakistan"
<i>By Mr. Raza Abbas Shah</i>
<i>CEO, Engineering Development Board,</i>
<i>Islamabad</i> | 12 ⁰⁰ hrs. |
| 7. "Review of the Resilient Supply Chains for the Nuclear Power in Pakistan"
<i>By Engr. Waqar M. Butt</i>
<i>S.I., T.I., Ex-member Engineering, Pakistan Atomic Energy Commission,</i>
<i>Islamabad</i> | 12 ⁴⁵ hrs. |
| 8. Conclusions | 13 ¹⁵ hrs. |

3. Presentations as per Programme

3.1. Welcome Address of 24th Symposium

by

President PAE, Dr.-Ing. Jameel Ahmad Khan

The Pakistan Academy of Engineering

24th Symposium “Resilient Supply Chains for Pakistan ”

Held on June 25, 2022

ONLINE

Address of the President,
Dr. -Ing. Jameel Ahmad Khan

Respected Speakers,
My dear fellow Engineers,
Honourable Guests,
Ladies and Gentlemen!

WASALAMUN ALA MANIT-TABAUH-HUDA

I am extremely pleased to see you online.

I am privileged to welcome you and express my gratitude to you for your valuable participation in our prime event, that is the 24th Symposium on an extremely important and complex subject.

Our national economy depends upon supply chains. Globalization has made the supply chains vulnerable. Disruptions occur in today’s uncertain and turbulent market. Therefore, resilience becomes increasingly a subject of paramount concern. Management of resilient supply chains will ensure a fully integrated efficient and effective supply chains, capable of creativity and sustaining competitive advantage.

Another Important topic that has emerged in the field of supply chain management is supply chain sustainability. Models have been prepared to evaluate the performance of supply chain management. Sustainability and resilience factors have been identified.

The increased complexity calls for more powerful tools to be brought in the performance measurement and evaluation.

Supply Chain Resilience quantitative models are fairly new effort. There is a requirement to create risk management culture within the business on the same lines as Total Quality



Management. It has been wisely advised that there should be continuous communication among informed employees.

According to MIT Prof. Yossi Sheffi, threats to supply chain abound, natural disaster, accidents, internal disrupting, ever-shrinking product life cycles, volatile and unpredictable markets.

Pakistan Academy of Engineering brings forth subjects for discussion, which have not been addressed elsewhere. Our learned speakers will present reviews of resilient chains in respects of important economic sectors viz. Energy, Food, Industries and Nuclear Power. The Government has to step in to develop whole sum strategies for building resilient supply chains for the country.

I sincerely hope that our audience will stand benefitted with the presentations made by our learned speakers. Our profound gratitude to them.

Thanking you.

Ladies & Gentlemen!

I sincerely hope you will enjoy to listen to our learned speakers on the very complex subject. I thank **Prof. Engr. Syed Iqbal Hashmi, Mr. Masoor Khan, Engr. Waqar M. Butt Abdul Ghafoor** and **Waseem Ahmed**, who very kindly consulted to grace the event by bringing forth their considered views.

Thanks You



3.2. "Strategies for Building Resilient Supply Chains for Pakistan"

by

Prof. Engr. Syed Iqbal Hashmi, Ex-Managing Director, SKF Pakistan, Karachi.

Strategies for Building Resilient Supply Chains for Pakistan

by

Engr. Syed Iqbal Hashmi

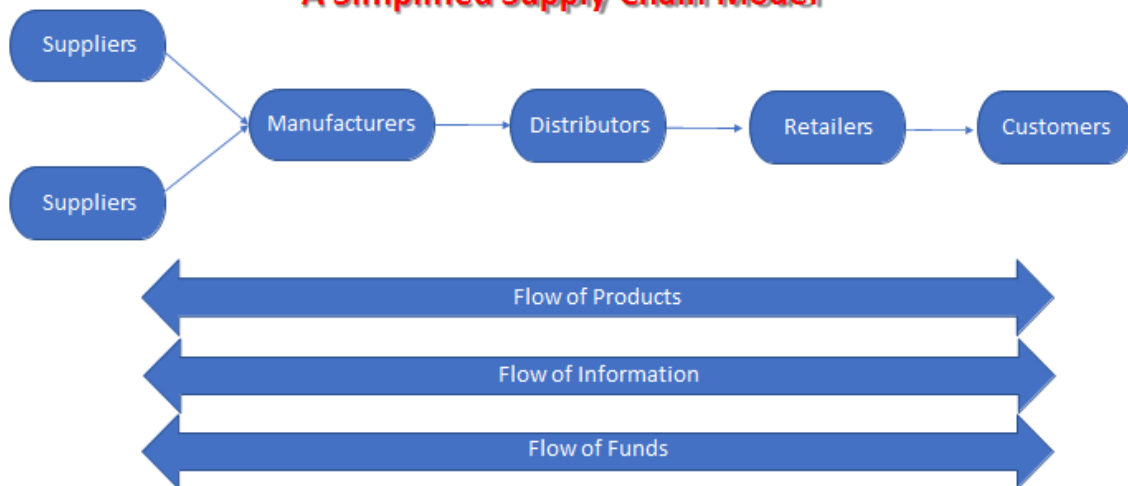
Strategies for Building Resilient Supply Chains for Pakistan

- 1. Complexities of Supply Chain Models**
- 2. Supply Chain Risks & Disruptions**
- 3. Supply Chain Risks of Pakistan in Global Perspective**
- 4. Supply Chain Risk Assessment Techniques**
- 5. Matching Supply Chain Risks with Capabilities**
- 6. Strategies for Building Sustainable Supply Chains**
- 7. Recommendations for Building Resilient Supply Chains for Pakistan**



1. Complexities of Supply Chain Models

A Simplified Supply Chain Model



1. Complexities of Supply Chain Models

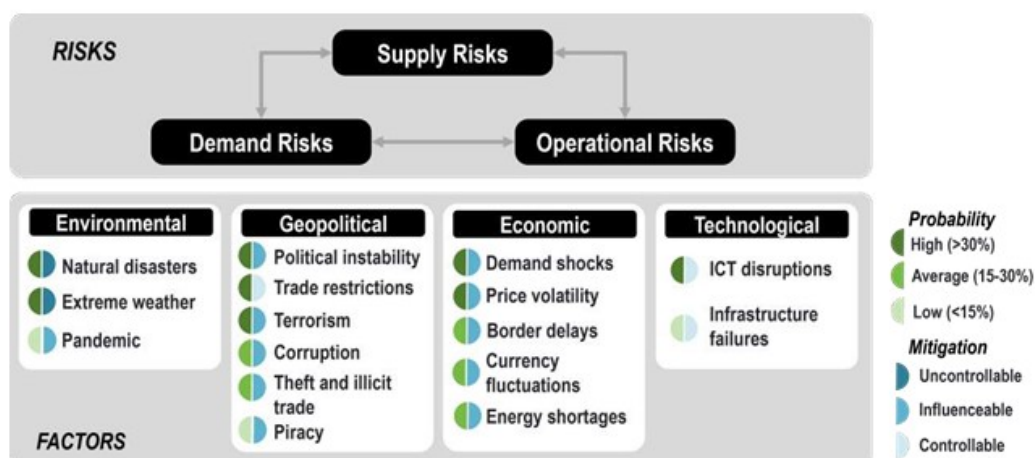
A Complex Supply Chain Model in Reality



2. Supply Chain Risks & Disruptions

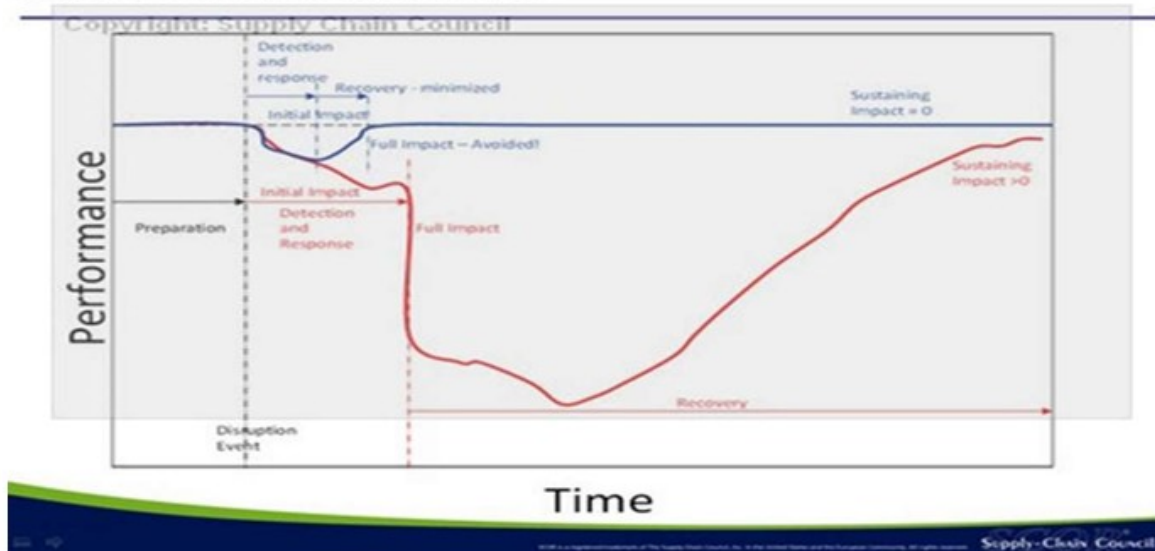
- **Definition of Supply Chain Risk**
- "Variation in the distribution of possible supply chain outcomes, their likelihood, and their subjective values".
- **Supply Chain Risks at Micro Level:**
 - Intra-Department Risk
 - Inter-Department Risk
 - Intra-Organizational Risk
 - Inter-organization Risk
- **Supply Chain Risks at Macro Level:**
 - Internal Country Risk to Supply Chain
 - Intra-Country Risk to Supply Chain

2. Supply Chain Risks & Disruptions



2. Supply Chain Risks & Disruptions

Supply Disruption Profiles



2. Supply Chain Risks & Disruptions

SCOR Model of Risk Management



3. Supply Chain Risks of Pakistan in Global Perspective

- Trade Wars
- Rising Demand
- Demand Slowdown
- Product Safety
- Sustainability – Triple Bottom Line:
 - Environmental
 - Economic
 - Social
- Weather-Related Disruptions
- Waste Disposal
- Water Preservation
- Industrial Unrest
- Hazardous Products
- Battles at the Border
- Terrorism
- Agile/Lean/JIT Supply Chain
- Disaster Management System
- Lesser Control on Extended Supply Chain
- Pandemic
- Fire
- Recycling/Reusing/Reducing

4. SC Risk Assessment Techniques – Qualitative

Probability-Impact Matrix
IMPACT

	Trivial	Minor	Moderate	Major	Extreme	
P R O B A B I L I T Y	Rare	LOW	LOW	LOW	MEDIUM	MEDIUM
	Unlikely	LOW	LOW	MEDIUM	MEDIUM	MEDIUM
	Moderate	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH
	Likely	MEDIUM	MEDIUM	MEDIUM	HIGH	HIGH
	Very Likely	MEDIUM	MEDIUM	HIGH	HIGH	HIGH



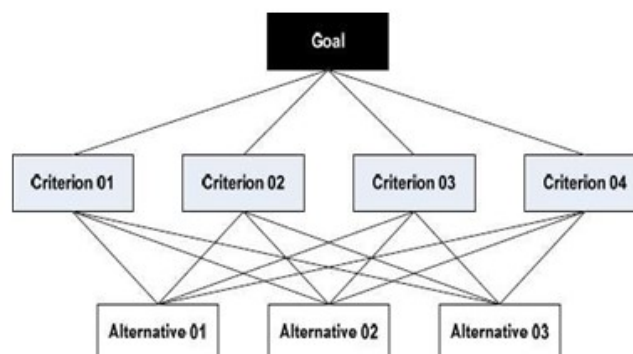
4. SC Risk Assessment Techniques – Qualitative

Failure Mode and Effect Analysis (FMEA)

Failure Mode	Severity	Probability of Occurrence	Probability of Detection	Risk Preference Number
Selecting Wrong Supplier	9	3	7	189
Quality Issue	6	3	9	162
Delivery Issue	3	4	8	96

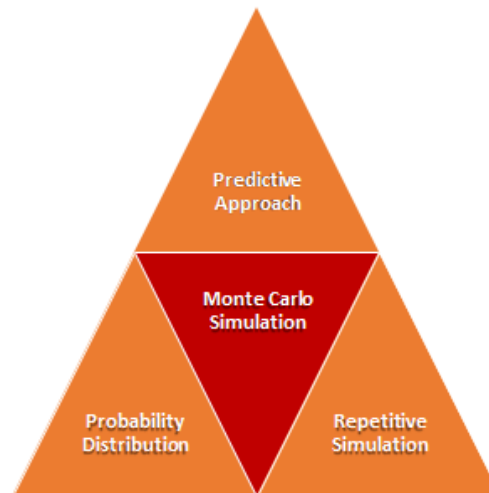
4. SC Risk Assessment Techniques – Quantitative

Analytical Hierarchy

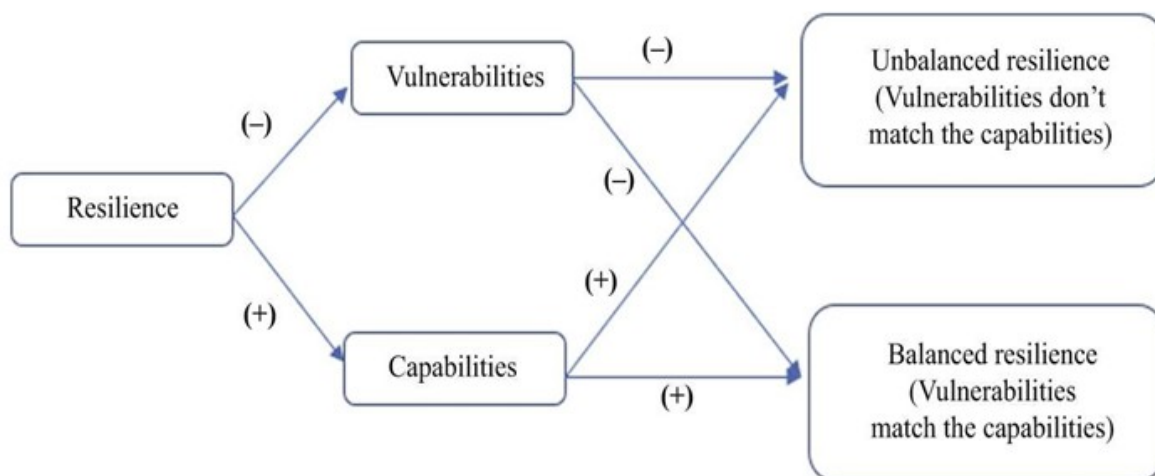


4. SC Risk Assessment Techniques – Quantitative

Monte Carlo Simulation



5. Matching Supply Chain Risks with Capabilities

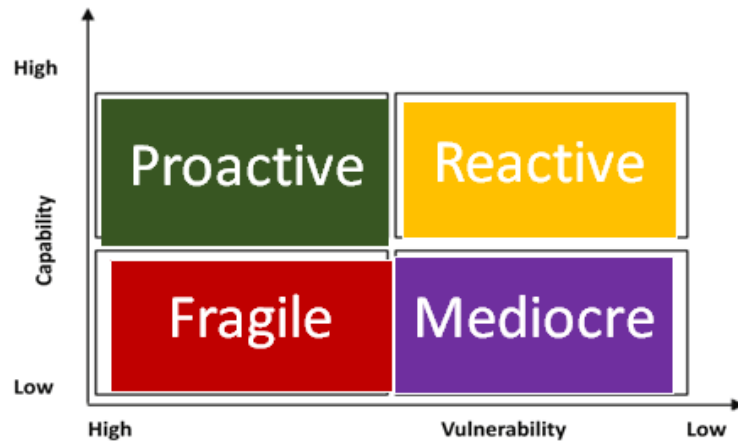


Source(s): Adapted from Pettit *et al.*, 2010



5. Matching Supply Chain Risks with Capabilities

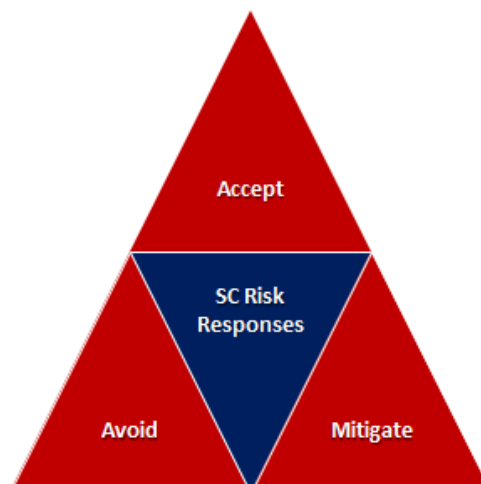
Capability Vulnerability Matrix



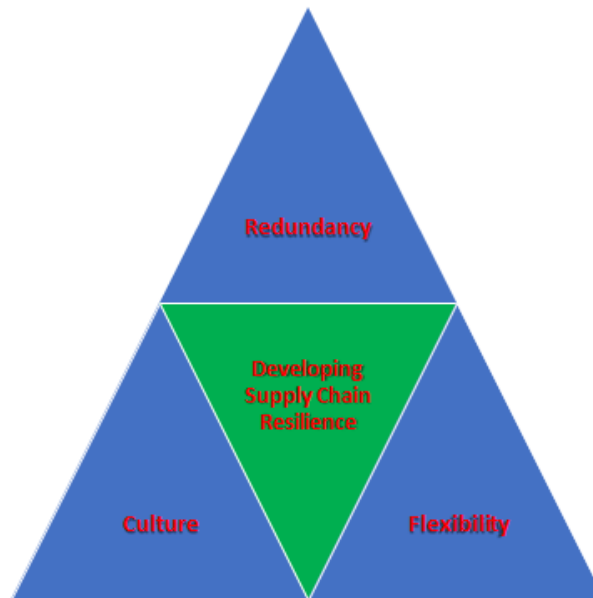
Source(s): Adapted from Steven *et al.*, 2015

5. Matching Supply Chain Risks with Capabilities

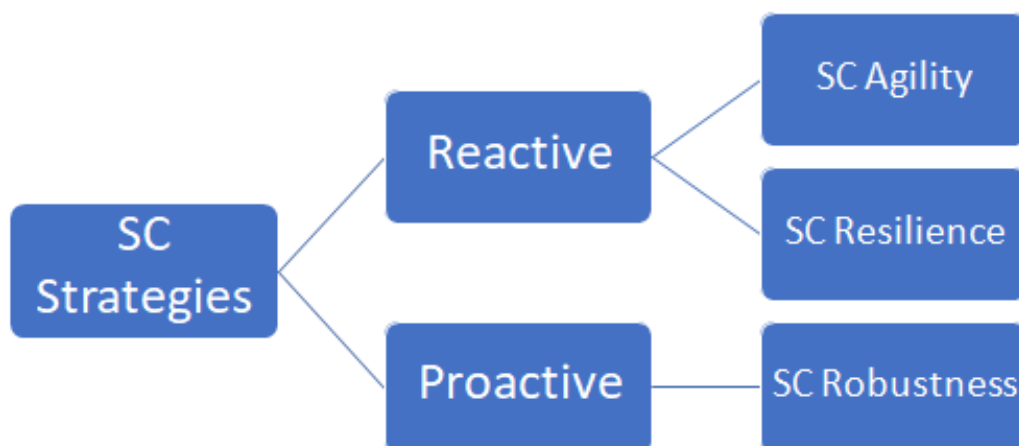
SC Risk Responses



5. Matching Supply Chain Risks with Capabilities



6. Strategies for Building Sustainable Supply Chains



6. Strategies for Building Sustainable Supply Chains

Reactive Approaches – Effect Oriented:

1. SC Resilience: Returns to its original state after getting disturbed

- Alertness
- Preparedness
- Flexibility

2. SC Agility: Ability to come back to normalcy quickly

- Responsiveness
- Joint Planning

Reactive Examples:

- Multiple Sourcing
- Safety Stocks
- Factor of Production Backup

Proactive Approach – Cause Oriented

Supply Chain Robustness: Ability of a supply chain to resist change without adapting its initial stable configuration

- Ability to Resist
- Ability to Avoid

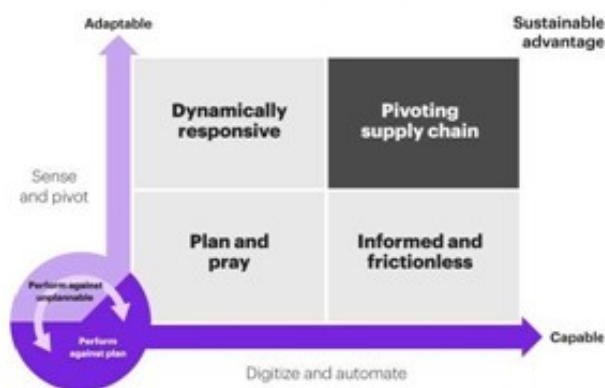
Proactive Examples:

- Selection of high-quality and high on-time delivery suppliers
- Supplier development & integration
- Preventing measures for geopolitical risks
- Flexibility
- Postponement
- Flow
- Factor of Production Redundancy

6. Strategies for Building Sustainable Supply Chains

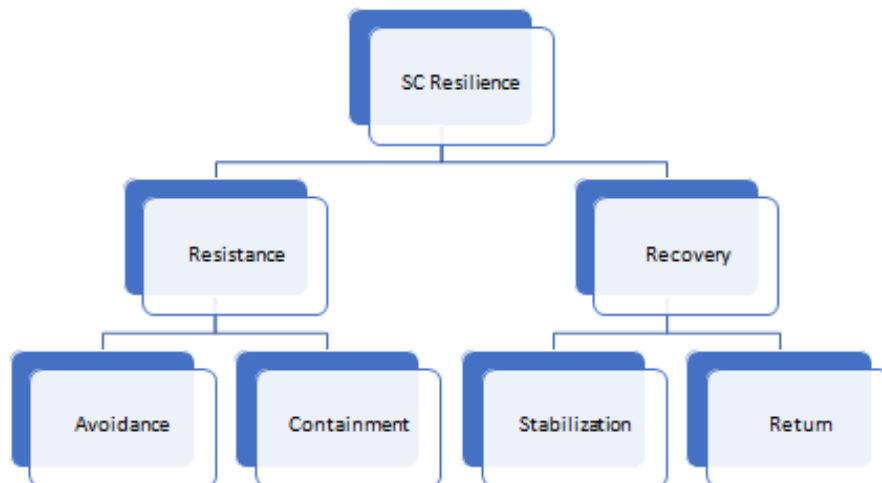
Resilience Provides Sustainable Competitive Advantage

Figure 1
 To be resilient, a supply chain must continually sense and pivot



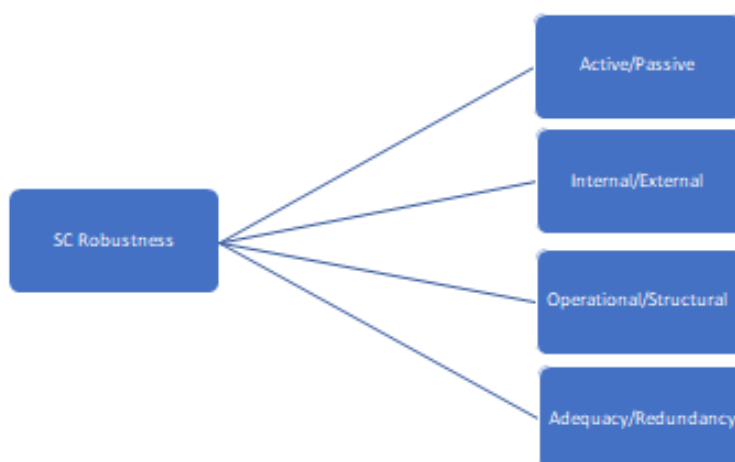
6. Strategies for Building Sustainable Supply Chains

Supply Chain Resilience Strategies



6. Strategies for Building Sustainable Supply Chains

A reduction in complex organization structures, complex processes, maintaining excess resources, and developing more stable processes that resist SCRs.



6. Strategies for Building Sustainable Supply Chains

Characteristics of Resilient Supply Chain



7. Recommendations for Building Resilient Supply Chains for Pakistan

- **Competitive Advantage is a Dynamic Concept**
- **Developed Countries are Building Competitive Advantage on a Combination of IT & SC**
- **First Thing First – Focus on Vulnerabilities**
- **Our Primary, Secondary & Tertiary Sectors are Dependent upon Foreign Technologies**
- **Industries Dependent upon Primary Sector Can't Compete in the Long Run**
- **Shift from Dependence to Interdependence to Develop Complex Supply Chains**
- **Develop Engineering Sector to Create Global Interdependency**
- **Engineers may Innovate on a Combination of SC & Engineering**
- **Establish Engineering & Technology Research Centres**
- **Who is on the Driving Seat?**
- **Build Redundancies on HR VS Redundancies in West on Machinery & Technology**
- **Green Posture is Critical for Sustainable Future**
- **Scaling Up of Business**



3.2. "Strategies for Building Resilient Supply Chains for Pakistan "

by Prof. Engr. Syed Iqbal Hashmi, Ex-Managing Director, SKF Pakistan, Karachi.

continued...

7. Recommendations for Building Resilient Supply Chains for Pakistan

- **Remove Inefficiencies and Cartels in Supply Chain**
- **Develop Redundancies in Strategic Areas**
- **Encourage Commercial Organizations to be a Part of CTPAT**
- **Organizations Should Focus on Triple Bottom Line**
- **Remove Subsidies but Reduce Input Cost**
- **Create Well Designed Supply Chain Linkages Locally as Well as Globally**
- **NDMA/CPEC should be headed by a CEO with Engineering & Commercial Expertise**
- **Role of NDMA be Changed to NSCMA**
- **Partnering with Chinese Companies for Warehousing/ Assembling/ Distribution/ Customer Service/ Reverse Supply Chain Taking Advantage of Postponement Principle**
- **Pakistan has Favorable Conditions to Become Satellite Country of China**
- **Licensing Joint Manufacturing with China**
- **Appoint Competent Commercial Attaché to Explore International Opportunities in SC**

*Customs Trade Partnership Against Terrorism



3.3. "Resilient Supply Chains for Fossils Fuel Suplies in Pakistan"

by

Mr. Masoor Khan, Chairman Oil & Gas Regulatory Authority (OGRA) Islamabad.



Oil & Gas
Regulatory Authority
Government of Pakistan

Presentation on Resilient Supply Chains for Pakistan (Oil) Masroor Khan, Chairman, OGRA

25.06.2022

1



Outline

Energy Mix

OIL

- Supply Chain Mechanism of Oil
- Major Oil Infrastructure
- Sales 2020-21
- FOTCO Jetty
- KPT Jetty
- WOP
- Role of OGRA
- PRM
- 20 Days Stock
- Resilient Oil Supply Chain?

Natural Gas

LNG
LPG

2



3.3. "Resilient Supply Chains for Fossils Fuel Supplies in Pakistan"

by Mr. Masoor Khan, Chairman Oil & Gas Regulatory Authority (OGRA) Islamabad.

continued...



Primary Energy Supplies approx

Gas including LNG	44 %
Oil	22 %
Coal	18 %
Electricity	15 %
LPG	1 %

3



Supply Chain Mechanism of Oil

- There are two sources of petroleum products i.e. (i). Local Refineries which produce products/stocks by processing the crude oil and, (ii). Imported.
- OMCs purchase the product from abroad through Sea via Cargoes.
- OMCs then transfer the same via pipeline and/ or through Tank Lorries to their Storage depots. (Primary Movement).
- The OMCs then supply the product/stock from their depots to the retail outlets via tank lorries. (Secondary Movement).

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3.3. "Resilient Supply Chains for Fossils Fuel Supplies in Pakistan"

by Mr. Masoor Khan, Chairman Oil & Gas Regulatory Authority (OGRA) Islamabad.

continued...



Major Infrastructure

Ports / Jetties along with Designed and handled capacity	FOTCD 9 MMT (6.8 MMT handled) KPT 2.4 MMT (10.8 MMT handled) Cynergico SBM 12MMT (1.6 MMT handled)
Refineries Refining Capacity (Design) Yield 2020-21	5 20,341,467 MT 2,520,266 MS, 4,697,017 HSD
Storage Capacity (MT) at 22 designated IFEM locations: OMC Refineries Pipeline Crude	1,219,047 MS, 1,475,719 HSD 811,447 MS, 939,547 HSD 109,900 MS, 193,572 HSD 302,700 MS, 342,600 HSD 888,900
Tank lorries (average 40,000 liters (40MT))	12,000 Nos (400,000 MT) approx.
Major Pipelines along product transported	WOP 26", 786 KM (3,755,543 MT HSD) MFM 16", 18", 365 KM (2,756,090 MT HSD) KMK 16", 864 KM
Total Petrol Pumps (9,200) Storages	170,000 MT MS, 300,000 MT HSD

5



Sales 2020-21

Total Sales 2020-21	8,350,324 MS, 7,789,101 HSD
Imports 2020-21	5,926,529 MS, 3,222,578 HSD
Storage Capacity @ Sales 2020-21	53 days MS, 69 days HSD
Consumption Points	Punjab 64 % MS, 62 % HSD KP 10 % MS, 12 % HSD Sindh 22 % MS, 22% HSD Balochistan 3% MS, 1 % HSD GB & AJK 2% MS, 3 % HSD

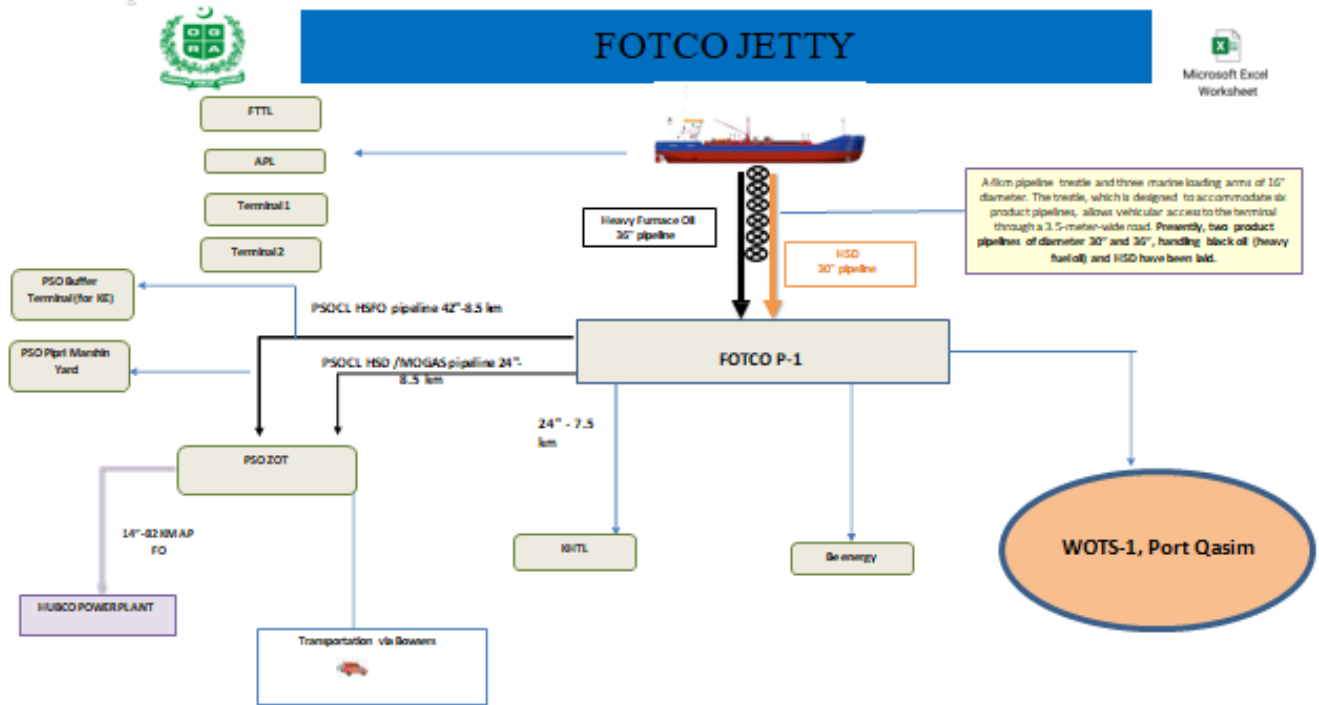
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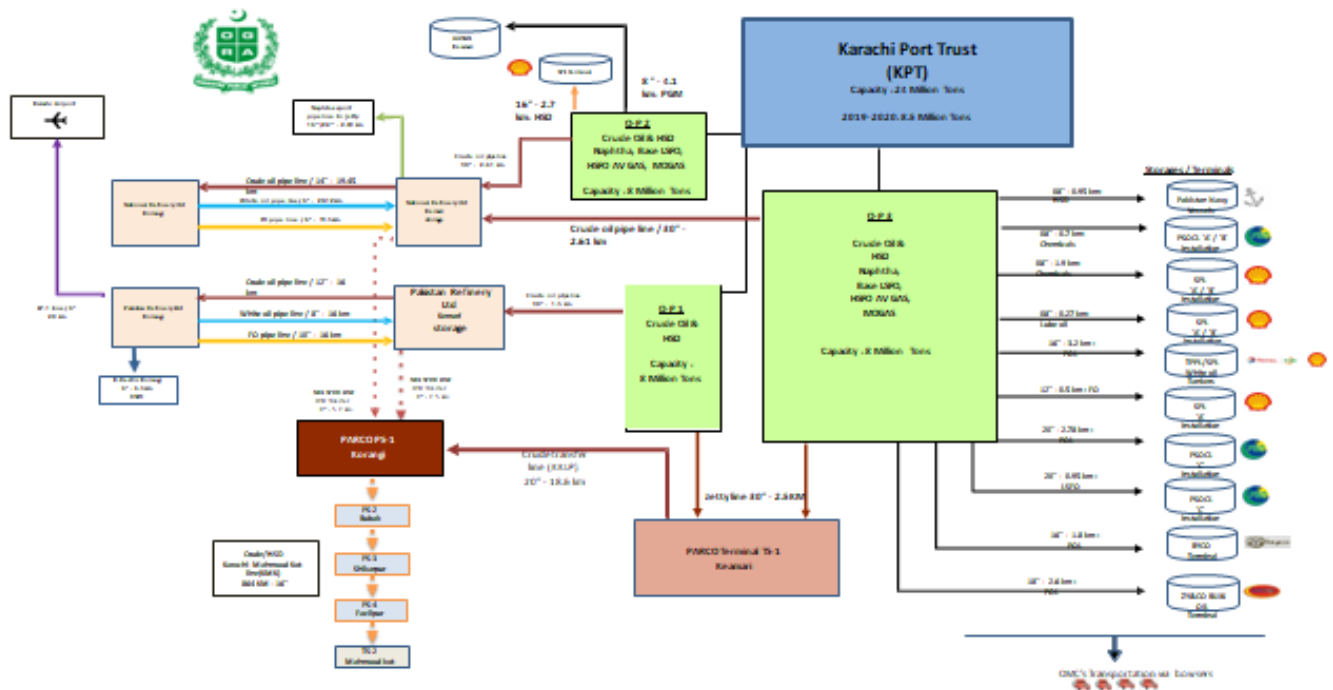
3.3. "Resilient Supply Chains for Fossil Fuel Supplies in Pakistan"

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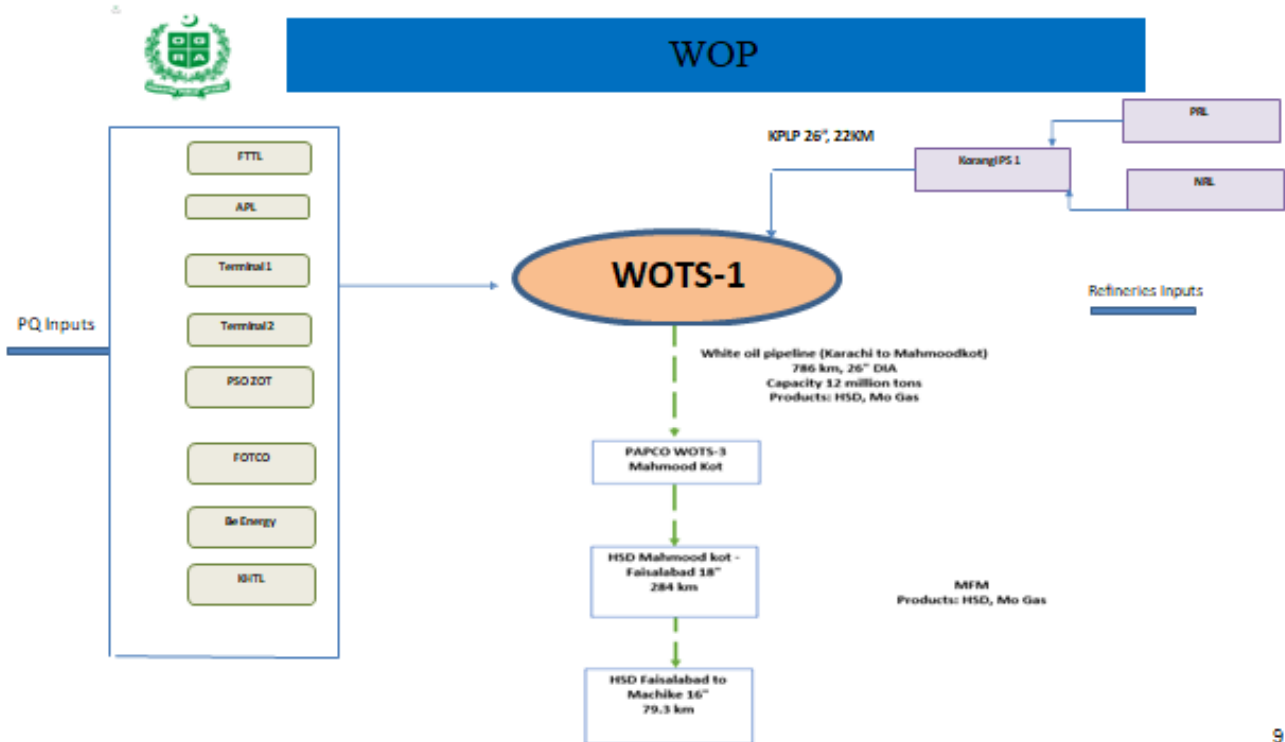


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3.3. "Resilient Supply Chains for Fossils Fuel Supplies in Pakistan"

by Mr. Masoor Khan, Chairman Oil & Gas Regulatory Authority (OGRA) Islamabad.

continued...



9



Role of OGRA

1. The import/export, demand/supply, refineries production/shutdown, Maintenance of Crude Oil, Petroleum Products Stock by Refineries and Oil Marketing Companies (OMCs) regulated under rule 7, 8, 9, 10, 30A, 30B of Pakistan Petroleum Rules, 1971 has been transferred to OGRA in 2022.
2. OGRA has established Oil Supply Chain Department which has started to convene a Product Review Meeting (PRM), on monthly basis to ensure the availability of 20 days stocks cover at all times by the OMCs for uninterrupted supply of the product by OMCs through their Pumps to the commuters. During the PRM the following is analysed in respect of HSD, Mo gas, JP fuel:-
 - (i) Products/Stocks position with the OMCs.
 - (ii) OMCs demand based on historical consumption and growth rate of the month.
 - (iii) Refineries Production and allocation to OMCs.
 - (iv) Deficit.
 - (v) Import volume OMC wise based on laycan and berthing / discharge dates.

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3.3. "Resilient Supply Chains for Fossils Fuel Supplies in Pakistan"

by Mr. Masoor Khan, Chairman Oil & Gas Regulatory Authority (OGRA) Islamabad.

continued...



PRM by OGRA

After issuance of PRM following issues are monitored:-

1. Import plan vs actual imports by the OMC's
2. Issues related to ports and pipelines.
3. Tanker plan of OMCs and Refineries (laycan/berthing, discharge etc).
4. Tweaking of import plan as and when requested by the OMC's.
5. Days cover of OMCs and issuance of regulatory directions/SCN.
6. Field inspection of Depots and retail outlets through Enforcement Department.

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20 days stock

Day cover of 20 days stock is determined on the basis of following:-

- (i) Product in Storage Depots of OMC.
- (ii) Product in storages of WOP.
- (iii) Product in storages of MFM.
- (iv) Product in berthing vessel or being discharged.

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3.3. "Resilient Supply Chains for Fossils Fuel Supplies in Pakistan"

by Mr. Masoor Khan, Chairman Oil & Gas Regulatory Authority (OGRA) Islamabad.

continued...



Resilient Oil Supply Chain?

Pakistan has a resilient oil supply chain. However, addressing of following issues may further make it fool proof-

- i. Port congestion results in delay in dispatch of products apart from demurrages. It is a need of time to construct another jetty ideally at Khalifa Point.
- ii. Night Navigation at FOTCO.
- iii. pipeline connectivity between KPT and PQA/FOTCO jetty.
- iv. Pipeline transportation from Machoke to KP (FOC is already undertaking said project)
- v. Introduction of trading hub for storages like Fujairah and Singapore.
- vi. open access regime.
- vii. Upgrading of Hydroskimming Refineries to increase yield as per market demand (PRL has started)
- viii. Installation of new refinery of greater refining capacity (Khalifa Refinery is already planned) This will save Forex, availability of more products and job creation.
- ix. Enhancing local crude production to reduce sea reliance or through pipeline connections with neighbouring crude exporting countries.

13



Natural Gas

IMPORTED RLNG & PROVINCE WISE INDIGENOUS GAS SUPPLIES TO SNGPL & SSGCL

PROVINCE	MMCFD
Punjab	83
Khyber Pakhtunkhuwa	398
Sindh	1,192
Balochistan	333
RLNG	969
Total:	2,975 (33%)

SECTORAL GAS CONSUMPTION

SECTOR	MMCFD	%AGE
Domestic	862	20
Commercial	70	2
Industrial	365	8
Fertilizers	829	19
Cement	142	3
Captive Power	203	5
Power	1,305	30
LNG	108	3

Currently 969 MMCFD i.e 33% of Total gas supplies is being transported through sea route. In case of war like situation, said supplies may be disrupted. Therefore, to address such risks, import of gas through land routes i.e. Iran Pakistan (IP) or Turkmanistan, Afghanistan, Pakistan and Iran (TAPI) projects are essential to promote resilience in gas supply chain.

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3.3. "Resilient Supply Chains for Fossils Fuel Suplies in Pakistan"

by Mr. Masoor Khan, Chairman Oil & Gas Regulatory Authority (OGRA) Islamabad.

continued...



Natural Gas

SSGCL		SNGPL		SSGCL		SNGPL	
Sindh	3,367	Punjab	7,506	Sindh Interior	23,198	Punjab	118,987
Balochistan	776	KPK	1,416	Sindh-Karachi	16,959	KPK	24,041
Others	0	Others	703	Balochistan	8,293		
Total:	4,143	Total:	9,625	Total:	48,450	Total:	143,028
Gas Transmission Network		13,768 Km		Gas Distribution Network		191,478 Km	

- Extension of Transmission Pipeline Network to enhance Pipeline Capacity.
- Transparent & Open allocation of pipeline capacity and to establish a uniform contractual framework for the third-party access arrangements cross country.
- Necessary measures should be taken regarding maintenance activity of the installations/ regulating stations and identification/ rectification of bottle necks to ensure Pipeline Capacity enhancement alongwith reduction in UFG.

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LNG

- Natural Gas constitutes around 44% of Pakistan's primary energy mix with present estimated un-constrained demand of 6 Bcfd against supply of around 4 Bcfd.
- Being a less polluting source of energy, Natural Gas is a fuel of choice and over the years there has been a significant rise in demand by the residential, commercial and industrial sectors which has resulted in indigenous natural gas shortfall.
- Two LNG re-gasification terminals i.e. EETL and PGPCL having peak re-gasification capacities of 690 and 750 MMcf/d respectively were setup at Port Qasim Karachi by the private sector.
- Two more such project developers have been granted construction licenses by OGRA i.e. Tabeer Energy and Energas, to build LNG re-gasification terminals at Port Qasim as integrated project structures.
- OGRA has issued Provisional licenses to five companies FOR LNG Virtual Pipeline projects.

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3.3. "Resilient Supply Chains for Fossils Fuel Suplies in Pakistan"

by Mr. Masoor Khan, Chairman Oil & Gas Regulatory Authority (OGRA) Islamabad.

continued...



LNG

To ensure sustainable and resilient LNG supply, the following is required to be ensured:

- i. Urgent development of a LNG storage facility, preferably land based, of an appropriate capacity by public or private sector
- ii. Utilization of the existing LNG Terminals unutilized and excess capacity
- iii. Expeditious implementation of the Virtual LNG Pipeline projects keeping in view all the safety aspects
- iv. Development of additional LNG Terminals
- v. Construction of additional gas transmission pipeline network
- vi. Liberalization of Gas market and implementation of the third-party access regime for pipelines and LNG Terminals.
- vii. No additional exposure of the Government in LNG business
- viii. Less reliance on spot cargos and more on medium and Long-term LNG contracts
- ix. Hedging of LNG prices
- x. Locking in spot LNG cargos earlier than normal

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LPG

Demand	5,000 MT per day
share in energy mix	1.3 %
Storage Capacity	125,000 MT
Producers	11
Storage Plants	282
Import Terminal	3
Storage on Wheels	2,000

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3.4. "Resilient Supply Chain for the Nuclear Power in Pakistan"

by

Eng. Waqar M. Butt S.I., T.I., Ex-Member Engineering, Pakistan Energy Commission, Pakistan.

24th SYMPOSIUM RESILIENT SUPPLY CHAIN FOR PAKISTAN

JUNE 25, 2022
THE PAKISTAN ACADEMY OF ENGINEERING

OVERVIEW OF SUPPLY CHAIN FOR NUCLEAR POWER PLANTS
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SCHEME OF PRESENTATION

- NUCLEAR POWER PROGRAM OF PAKISTAN
- GOALS / TARGETS OF NUCLEAR POWER PLANTS
- OBJECTIVES OF SUPPLY CHAIN FOR NPPs
- MAJOR COMPONENTS OF SUPPLY CHAIN
- SAFE OPERATION OF KANUPP WITHOUT VENDOR SUPPORT

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3.4. "Resilient Supply Chain for the Nuclear Power in Pakistan"

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continued...

NUCLEAR POWER PROGRAM OF PAKISTAN

- SIX NUCLEAR POWER PLANTS IN OPERATION (TOTAL GENERATION 3530MWe)
- ONE NUCLEAR POWER PLANT IN DECOMMISSIONING
- OTHERS IN PLANNING PHASES

FIRST NUCLEAR POWER PLANT – KANUPP

- 137 MWe
- COMMISSIONED IN AUG 1971
- PERMANENTLY SHUTDOWN FOR DECOMMISSIONING AFTER 50YEARS OF OPERATION

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NUCLEAR POWER PROGRAM OF PAKISTAN

300 MWe NPPs AT CHASHMA

		C O D	T A R I F F
•	C-1	325MWe SEPT 2000	6.6076
•	C-2	325MWe MAY 2011	10.9123
•	C-3	340MWe DEC 2016	15.4134
•	C-4	340MWe SEPT 2017	15.3394

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continued...

NUCLEAR POWER PROGRAM OF PAKISTAN

1100MWe NPPs AT KARACHI

		CO D	TARIFF
• K-2	1100 MWe	MAY 2021	12.2461
• K-3	1100 MWe	APR 2022	NOT YET FINAL

FUTURE PROGRAM

- GOP ENERGY MIX 8800 MWe NUCLEAR BY YEAR 2030
- 1100MWe AT CHASHMA SITE (CONTRACT FINALIZATION PHASE)
- ADDITIONAL SITES IN PLANNING
- DEVELOPMENT OF INDIGENOUS NPP (UNDER CONSIDERATION)

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GOALS / TARGETS OF NUCLEAR POWER PLANTS

- SAFE AND SUSTAINABLE OPERATION OF NPPs
- AVAILABILITY TARGET OF > 90%
- BASE LOAD OPERATION
- NORMALLY 14 MONTHS OPERATION CYCLE FOLLOWED BY 6-8 WEEKS RE-FUELLING OUTAGE (RFO)
- MULTIPLE LEVEL PERFORMANCE MONITORING / ASSESSMENT
 - PLANT LEVEL (NPP)
 - CORPORATE LEVEL (PAEC)
 - NATIONAL REGULATORY BODY (PNRA)
 - INTERNATIONAL REVIEWS (IAEA, WANO)
- PERFORMANCE INDICATORS (PIs)
 - SAFETY PIs
 - OPERATION / RELIABILITY PIs
- THE PERFORMANCE OF NPPs AROUND THE WORLD IS MONITORED / REVIEWED AND REPORTED ON INTERNATIONALLY AGREED PIs (NEI, IAEA, WANO ETC)

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OBJECTIVES OF SUPPLY CHAIN FOR NPPs

- ASSESSING THE CURRENT NATIONAL SUPPLY CHAIN AND CAPABILITIES OF PAEC FOR ENHANCING SAFETY, RELIABILITY AND SUSTAINABILITY OF NUCLEAR POWER PROGRAM
 - COMBAT THE RESTRICTIONS DUE TO EMBARGOES AND INTERNATIONAL SANCTIONS
 - MINIMIZE DEPENDENCE ON VENDOR COUNTRY / SUPPLIERS
 - LIFE TIME SUPPORT
 - DESIGN LIFE EXTENSION 60 YEARS → 80/100YEARS
 - AGEING MANAGEMENT
 - OBSOLESCENCE
 - INDIGENOUS DESIGN / ENGINEERING SUPPORT FACILITIES / SERVICES DEVELOPMENT
- WITH THE SUPPLY CHAIN PROGRAM FOR NUCLEAR POWER PLANTS, PAEC IS ON THE PATHWAY OF SELF RELIANCE AND TECHNOLOGICAL ENHANCEMENT LEADING TO INDIGENOUS NUCLEAR POWER PROGRAM IN PAKISTAN

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3.4. "Resilient Supply Chain for the Nuclear Power in Pakistan"

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continued...

MAJOR COMPONENTS OF SUPPLY CHAIN

1) HUMAN RESOURCES DEVELOPMENT

- MS/PHD PROGRAM
- PAKISTAN INSTITUTE OF ENGINEERING AND APPLIED SCIENCES (PIEAS)
- OPERATION / MAINTENANCE TRAINING CENTERS
 - KINPOEAT KARACHI
 - CHASHCENT AT CHASHMA
- O/M TRAINING FOR DIPLOMA HOLDERS
- PAKISTAN WELDING INSTITUTE (PWI)
- NATIONAL CENTER FOR NON-DESTRUCTIVE TESTING (NCNDT)
- MANAGEMENT TRAINING PROGRAMS
- SKILL DEVELOPMENT PROGRAMS
- CYBER SECURITY PROGRAMS

2) NUCLEAR FUEL SUPPLY / SUPPORT

- LIFE TIME SUPPORT BY VENDOR
- FOR KANUPP NUCLEAR FUEL WAS INDIGENOUSLY DEVELOPED
- SAFE STORAGE OF SPENT NUCLEAR FUEL
- NUCLEAR WASTE MANAGEMENT FACILITIES

- PAEC IS MAKING NUCLEAR FUEL FOR ITS RESEARCH REACTORS AND HAS THE CAPABILITY TO FABRICATE NUCLEAR FUEL FOR THE NUCLEAR POWER PLANTS

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MAJOR COMPONENTS OF SUPPLY CHAIN

3) DESIGN AND ENGINEERING SUPPORT FACILITIES

- PROCESS AND EQUIPMENT DESIGN CENTERS
 - SAFETY UPGRADES / IMPROVEMENTS
 - DESIGN LIFE EXTENSION
 - LESSONS LEARNT
 - OPERATING EXPERIENCE FEED BACK (OEF)
- EQUIPMENT MANUFACTURING WORKSHOPS FOR SAFETY CLASS EQUIPMENT AND SPARE PARTS
- I & C AND ELECTRICAL SYSTEMS / EQUIPMENT
- EQUIPMENT QUALIFICATION AND TESTING FACILITIES
- MOCK-UPS FOR MAINTENANCE TRAINING
- FULL SCALE PLANT SIMULATORS FOR OPERATOR TRAINING / LICENSING
- SPECIALIZED WELDING TECHNOLOGY
- NDT / NDE FACILITIES

- PAEC DESIGN AND ENGINEERING FACILITIES ARE ISO, ASME AND IEEE CERTIFIED FOR CONVENTIONAL AND NUCLEAR SAFETY CLASS EQUIPMENT MANUFACTURING.

4) FINANCIAL SUPPORT

- O/M BUDGET
- DEVELOPMENT PROJECTS FOR AGEING MANAGEMENT AND PLANT LIFE ENHANCEMENT
- DECOMMISSIONING FUND REQUIREMENT AT THE END OF DESIGN LIFE AND BEYOND
- DECOMMISSIONING AFTER 60-80 YEARS AND FOR NEXT 30-40 YEARS.

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continued...

SAFE OPERATION OF KANUPP WITHOUT VENDOR SUPPORT

- COMMERCIAL OPERATION OF KANUPP IN 1972
- VENDOR COUNTRY EMBARGO IN 1976
- TOTAL CUT-OFF OF
 - NUCLEAR FUEL SUPPLY
 - HEAVY WATER SUPPLY
 - SPARE PARTS SUPPLY
 - FUEL MANAGEMENT SUPPORT

- PAEC ACCEPTED THE CHALLENGE TO CONTINUE PLANT OPERATION WITHOUT VENDOR SUPPORT

- INDIGENOUS DEVELOPMENT FOR KANUPP OPERATION
 - LOCALLY DEVELOPED NUCLEAR FUEL
 - HEAVY WATER PRODUCTION
 - LOCAL DEVELOPMENT OF SPARE PARTS AND REPLACEMENT EQUIPMENT
 - TESTING AND QUALIFICATION OF NUCLEAR FUEL AND SAFETY CLASS EQUIPMENT
 - MANPOWER TRAINING PROGRAM (O/M)
 - CC&I FACILITIES
 - NDT / NDE AND ISI

- LOCAL NUCLEAR FUEL FABRICATION ALONG WITH UP-GRADATION AND REFURNISHMENTS LEAD TO SAFE OPERATION OF KANUPP FOR 50 YEARS (1971-2021)

- WITH PAEC'S INVOLVEMENT IN NPP SINCE EARLY 70'S, IT HAS DEVELOPED SUBSTANTIAL EXPERTISE IN MAJOR INFRASTRUCTURE SUPPORT
- LOCAL INDUSTRIAL SUPPORT AND FEW OTHER AREAS NEED TO BE FURTHER DEVELOPED.

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THANK YOU

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3.5. "Resilient Supply Chains for the Cash Crops in Pakistan"

by

Abdul Ghafoor and Waseem Ahmed, Institute of Business Management Sciences,
University of Agriculture Faisalabad.

REVIEW OF RESILIENT SUPPLY CHAINS FOR THE CASH CROPS IN PAKISTAN

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INSTITUTE OF BUSINESS MANAGEMENT SCIENCES,
UNIVERSITY OF AGRICULTURE, FAISALABAD

INTRODUCTION

- Agriculture sector contributes 22.7 percent to the GDP and provides employment to around 37.4 percent of the labour force.
- Resilient agriculture supply chains are particularly important for the rural communities.
- The growing complexity of the current business environment in which these agricultural supply chains operate demands more flexible and collaborative operations. These firms are more exposed to supply chain disruptions that arise, especially from natural disaster events.



3.5. "Resilient Supply Chains for the Cash Crops in Pakistan"

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INTRODUCTION

- Natural disasters are a major cause of supply chain disruptions and can result in major breakdowns of distribution linkages and production nodes, especially in rural areas with poor infrastructure and a lack of access to basic resources
- The food supply chains are under stress, with farmers facing lack of inputs (shortage of certified seeds, fertilizers, etc.), difficulties in obtaining agricultural machinery, lack of access to extension services and disruptions in distribution.

STRATEGIES FOR IMPROVING SUPPLY CHAIN RESILIENCE

- **Identifying strategic priorities**
 - Strategic decisions need to be implemented to improve supply chain resilience of cash crops
 - Standardization and quality standards Vs cost efficiency
 - Diversifying risk by using different suppliers and distribution channels in order to have sustainable supply



3.5. "Resilient Supply Chains for the Cash Crops in Pakistan"

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continued...

STRATEGIES FOR IMPROVING SUPPLY CHAIN RESILIENCE

- **Map supply chain vulnerabilities**
 - **Improving supply chain visibility**
 - Identify key stakeholders and supply chain nodes - who produces critical parts, who supplies raw materials and where are they sourced, produced and manufactured?
 - Different power relations and agency dynamics between stakeholders across the supply chain network

STRATEGIES FOR IMPROVING SUPPLY CHAIN RESILIENCE

- **Map supply chain vulnerabilities**
 - **Assessing vulnerability to disruption**
 - Comprehensively assessing the organisation's and its supply chain network's vulnerability to potential disruptions by a climate disaster or other potential shocks
 - Government needs to play a role to risk-reduction strategies to achieve long-term supply chain resilience, particularly in the context of climate change adaptation. Government needs to make necessary improvements.



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continued...

STRATEGIES FOR IMPROVING SUPPLY CHAIN RESILIENCE

• Improve collaboration and cooperation

- Coordination and collaboration is the communication of supply chain vulnerabilities, activities and operations across the supply chain.
- Coordination and collaboration supports the identification of interdependencies between supply chain nodes, transport links and organizations, and promotes the sharing of different resources among actors within a network.

STRATEGIES FOR IMPROVING SUPPLY CHAIN RESILIENCE

• Improve flexibility and responsiveness

- The aim of agility and flexibility is to improve supply chain responsiveness to changes in demand and supply of resources during and after disruptions
- Agility enables organizations and/or governments to respond quickly and effectively to changing, dynamic and uncertain outcomes of disasters, which is critical for relief and aid operations.



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STRATEGIES FOR IMPROVING SUPPLY CHAIN RESILIENCE

- **Improve knowledge management**
 - Knowledge management refers to a variety of activities, including mapping supply chain vulnerabilities and monitoring supply chain resilience to shocks; learning from experiences across the supply chain network; re-integrating learning from risk assessments back into supply chain design and consistently monitoring disruptions as much as possible.
 - Mapping and monitoring supply chain resilience allows managers and product designers to think about resilience as a key attribute of both products and supply chains.

ISSUES OF CASH CROPS IN PAKISTAN

- Water deficiency and drought conditions
- Long duration load shedding
- Poor extension services
- Absence of land reforms
- Absence of distribution of certified varieties
- High price of fertilizers and monopoly of companies
- Non-recommended and expired insecticides
- Conventional farming practices



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ISSUES OF CASH CROPS IN PAKISTAN

- Indirect access of farmer to main market
- Lack of cooperation between agricultural research, education & extension services
- Lack of modern post-harvest technologies

POSSIBLE SOLUTION FOR CASH CROP ISSUES IN PAKISTAN

- Construction of dams
- Privatization of extension in Pakistan
- Implementation of justice based land reforms
- Commercialization of certified seed at subsidized rates.
- Natural gas availability to fertilizer sector
- Reforms of pest warning and quarantine department



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Thanks



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