



**Examining the nature of resilience, especially around issues  
of risk and security in relation to critical national  
infrastructure and from catastrophic events**

**Muhammad Imran Khan \***  
*Greenwich University  
Karachi, Pakistan*

**Prof. Dr. Akhlas Ahmed \***  
*Greenwich University  
Karachi, Pakistan*

**ABSTRACT**

**Purpose:** The purpose of this research article is understand the concept of resilience and risk management in relation to the challenges of risk and security associated to critical national infrastructure as well as from the effects of catastrophic events, with emphasis on the case scenario of Pakistan. The objectives of this research article include establishing the importance of resilience in the risk management approaches and how it is integrated in the organizational strategies and Governmental Policies.

**Methodology/Sampling:** This is based on theoretical evolution and case study based approach to explore the depth of the issue related to critical national infrastructure and from catastrophic events.

**Findings:** The article highlights the issues and risks associated to the critical national infrastructure of the countries, with emphasis on the issues of critical national infrastructure of Pakistan. It analyzes the current status and need of establishing the resilient critical infrastructure in light of previous disastrous events in the country and discusses challenges associated with the development of the frameworks and strategies pertaining to the research question.

**Practical Implications:** Our study recommends how to initiate the basic approach towards the development of a resilient national infrastructure

**Keywords :** Resilience, risk management, critical national infrastructure, policies.

**Jel Classification: F23, M13**

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<sup>1</sup> Muhammad Imran Khan

<sup>2</sup> Prof. Dr. Akhlas Ahmed : drakhlas@greenwich.edu.pk

## 1. INTRODUCTION

Risk management as a discipline has been evolving since the beginning and so have the challenges associated with it; the theories of risk management and the practical work related to it has been changing with time and is constantly being updated. Risk management is an ongoing process that involves identification and measurement of different kinds of risks, setting a band of tolerance for those risks, informing the concerned parties of the risks and its impact on them and observing the process of managing risk for any modifications. The nature of different kinds of risks and their changing dynamics have forced the business organizations and the Governmental Authorities to adopt a much more holistic approach towards risk management due to the increasing uncertainty and inter dependency of different aspects with each other in the ecosystem. This tendency towards risk management processes have given way to resilience planning as the businesses and governance recognize the growing need of adapting to newer risk environments and plan before hand for any kind of system disruption or unpredictable threats.

Resilience, in an ordinary dictionary is a term for the ability of an individual to recover quickly from a shock or for a substance to come back to its original shape, that is, elasticity. For the purpose of this article, resilience is defined as the capability of a system and its associated sub-parts to foretell, understand, accommodate and recover from a stress or shock in time and in effective and efficient manner. Resilient risk management framework and processes are not only the necessity of business enterprises in today's world but are equally critical for Governments of countries because their objective is to mitigate or minimize risks associated with emergencies and catastrophic events, that is mandatory for the economic and public survival. The economic crisis of the year 2008 that hit the entire world in one way or the other was the triggering point for businesses around the world and the governments to push harder for the development of frameworks and strategies that are well equipped to respond to these unexpected or catastrophic events and are resilient enough to recover from their impact and adopting more holistic approaches and strategies to deal with, in such events.

A certain set of activities such as transportation, different industries like banking, financial institutions, hospitals, schools etc, and events take place on daily basis and are supported by different systems that exist to support their functions, and are critical for the basic functioning and security of any country; these array of different systems and assets make up the critical infrastructure on which lies the economy and country. Any issues arising or disrupting the functioning of these systems may have a huge impact on the country's well being and may cost the nation because all these systems are interdependent and interconnected, thus a disruption in one may well have its effect on the other sub systems as well. The rapid pace of globalization is posing major challenges for the organizations of critical infrastructures due to the abundant creation of digital technologies and increasing complexities of the contemporary world, in studying, analyzing and predicting of risks threatening the smooth running of the systems, making organizational resilience a necessary component Governmental strategies and policies.

The Government has the responsibility of securing and protecting the critical national

infrastructure, developing and defining the goals and devising strategies to reduce the risks associated with the national infrastructure and developing a resilient set of policies and objectives to respond to any kind of unpredicted or significant disaster or event that may pose a threat to the nation or its functioning. A critical infrastructure is the term applied to those that are providing services that are basic to the security of the nation and that makes it the core responsibility of the government and different organizations to manage them, identify and assess the risks threatening them and the strategies to handle and safeguard the national infrastructure to mitigate the impact and reduce vulnerability.

The purpose of this research article is understand the concept of resilience and risk management in relation to the challenges of risk and security associated to critical national infrastructure as well as from the effects of catastrophic events, with emphasis on the case scenario of Pakistan. The objectives of this research article include:

- o Establish the importance of resilience in the risk management approaches of the contemporary world and how it is integrated in the organizational strategies and Government Policies.
- o The issues and risks associated to the critical national infrastructure of the countries, with emphasis on the issues of critical national infrastructure of Pakistan.
- o Understand and analyze the current status of the national infrastructure and the policies and strategies that exist for its governance and discussing its shortcomings with reference to different scenarios and catastrophic events.
- o The need to develop resilient policies and strategies to respond better to these predictable and unpredictable events that have an adverse impact on the infrastructure of the country and the nation as a whole.
- o The recommendations based on the analysis of the current situation and its shortcomings, stating references from the plans of the developed nations to present examples on how strategies and policies that is resilient can be developed.

It is stated that Asia and Pacific region are the most catastrophic event prone regions of the globe. Last year in 2013 alone the region suffered US\$ 128 billion cost as a result of natural disasters that effected these regions and effected approximately 57 million people making it imminent that risk reduction and resilient strategies be integrated into the developmental plans and policies to mitigate vulnerability that is predicted to rise with upcoming climate changes and population growth. Where globalization has contributed to the increased complexities and challenges posed to the national infrastructures, there at the same time it has provided a massive opportunity in the face of technological development and interlinking of the world. This was only natural disaster statistics. Other events and disasters pertaining to numerous other aspects of the nation need to be considered as well, and in Pakistan being it a developing nation

needs to have resilient risk management systems and policies for its critical infrastructure considering the growing terrorism, population explosion, impact of various economic indicators and for its development and progress.

## 2. LITERATURE REVIEW

There are many researches and studies conducted in relation to resilience and risk management as well their association with the critical national infrastructure and the challenges posed to its security from catastrophic events or sudden happenings. Some of the studies have been discussed here to provide a basic foundation for this study and develop a frame work to address the research objectives.

M. Sutter in his research report titled “Resilience and Risk Management in Critical Infrastructure Protection Policy: Exploring the Relationship and Comparing its Use” studies the relationship of resilience and risk management used in the development of protection polices and strategies of nations. The research states that theoretically this relationship can be defined in three alternate concepts being: (1) resilience as the ultimate objective of risk management, (2) resilience is a part within risk management and (3) resilience as an alternate option to risk management. Each of these perspectives have been analyzed in different contextual environments and explained with different examples in the research study. The study concludes that the first theory does not have any direct effect on the current policies and strategies, whereas the second approach is found more relevant to Critical Infrastructure Protection policies and the third concept is found to be the emerging approach where it will be integrating all the risks under one concept and plan. The results state that the CIP strategies of Switzerland have the first two perspective embedded in it but still are a long way from the third concept and is recommended that more light on the second perspective can support the application of a much more elaborate Critical Infrastructure Protection policies.

Smith and Fischbacher in their research article (2009) “The Changing Nature of Risk and Risk Management: The Challenge of Borders, Uncertainty and Resilience” has discussed some of the significant factors concerned with risk management that may help the policy makers and practitioners respectively. It discusses the different kinds of events that impose risk that do not apply traditional risk management approaches on both corporate and Governmental level. It refers to the growing tendency towards resilience being included in strategic decisions and devising of policies. It further discusses the concept of risk and resilience and the systems built around it to respond and deal with significant catastrophic events with high level of uncertainty and newer forms of risks that are not conventional and require much more than traditional policies to protect the national infrastructure and maintain its security .

Shekhar and Saxena did a research article “Anatomy of Crisis Management: A Case Study Focusing on Major Crisis within India” in which they discussed the issued that the developing country like India is facing in the contemporary world. These issues discussed included economic problems, financial crisis, food and water issues and other problems pertaining to the developing country. The article discusses crisis management

and its goals and advantages as well as different theoretical concepts of crisis management. They discussed the basic crisis management model, the contingency planning, the theory of structural-functional systems and the innovation theory. They further discussed the different kinds of crises and their impact on India. Different theories and best practices regarding crisis management of the country has been stated in the article and suggested that a global economic restructuring is required to address the restructuring need of the economy globally including all the important sectors of the economy. It concludes that the crisis India is facing is much the contribution of the fast and rapid development of the country which has negatively affected its environment and different models and theories have been mentioned to provide a framework on how to go about addressing these issues (Shekhar & Saxena, 2007).

Clair and Pearson in “Reframing Crisis Management” studied and analyzed the crisis management concept in the context of an organization and stated that over the years its effect on an organization has gained tremendous strength. In this research article the authors have taken a multidisciplinary approach to crisis management taking insight from present information and data available and integrated different perspective including psychological, technological-structural and socio political perspectives. The concept of crisis management and crisis in an organization has been discussed elaborately in the research article and a basis has been provided depicting the process of crisis management and how the different perspectives can be simultaneously used to derive the suggested multidisciplinary approach. The research concludes offering eight different propositions linking perspectives of crisis management to the organizational crises and developing a framework illustrating the approach. The article recommends the future researchers intrigued by crisis management researches to partner the conceptual framework with the ground realities of the world to put the theories in actual practice .

Moteff in his report “Critical Infrastructure Resilience: The Evolution of Policy and Programs and Issues for Congress” studied the concept of resilience in the context of critical infrastructure, a society, a country and a nation and its importance in securing the securing of a nation as a whole. He analyzed the relationship of resilience and risk in terms of nation’s infrastructure elaborately and discussed different international policies to establish deeper understanding of the concept and its importance. Due to the fact that the study has been conducted keeping in account United States of America a significant part of the study is related to congress and their association and response to the infrastructure policies of the country .

A article written by Hanif Ajari “Enterprise Risk Management as an Integral Part of Corporate Governance” discusses enterprise risk management and its kinds considering the diversified rage of investment, financial and operational translations posing numerous risks to it makes it a significant set or portfolio of risks. It illustrates a model for management and measurement of these different kinds of risks and depicts computerized simulation techniques as a useful tool for mitigating of the risks to an enterprise. Crystal Ball software has been discussed in detail and has been stated as that may be a supportive simulation technique administer. The article concludes that the Crystal Ball software enables the management of an organization to understand the extent to which the risks may affect the organization and allows them to gain the required rate of risk with the

information collected. The article suggests that crystal ball be applied in ERM (Enterprise Risk Management) because it's a tool that works in the fluctuating economy and has been seen to fare the companies in downward scenarios of the global conditions .

### 3. RESEARCH PHILOSOPHY

This research study is a descriptive research as it aims at studying, understanding and analyzing the current scenario and examine it with the support of data that pre exists so as to establish the relationship in detail. It attempts to examine the need of a resilient critical infrastructure in the light of some of the catastrophic events that have taken place in the past and their disastrous impact on the nation as a whole with emphasis on Pakistan. Descriptive research methodology has been employed for the purpose of this research as it is stated that descriptive research is used to describe, explain and validate the research findings .

#### 3.1 The Scope of the Study

This research study aims to define the importance of critical infrastructure, in the case scenario of Pakistan, and the need to build resilient policies and strategies to protect the infrastructure from any catastrophic events in the future. It studies different risk management approaches and kinds of risks threatening a nation and its critical infrastructure. For this goal, the research study examines the policies of different countries to provide a framework for developing strategies and policies in Pakistan. The reference has been given of a few disastrous events in the history of Pakistan and their affect on the country's population and economy. Thus, the research aims to study analyze and recommend resilient critical infrastructure need in the global world of today and a basic framework derived from the different countries risk management policies and strategies.

#### 3.2 Critical Infrastructure and Resilience

Critical infrastructures are the foundation of an economy of a country and is significant for its nations wellbeing and it's protection and are a major important component for businesses, Governments and communities because they are dependent on it; as it is established already that infrastructure is a system that is interconnected and interdependent. This critical infrastructure is responsible for the day to day functioning of the economic and basic operative systems and comprises of continuous delivery of the electric power, supply of water, ongoing communications systems and the banking structure; that is, the basis of the system. It is continuously being evolved over the time and is primarily responsible for the global and modern world and living ways that we are accustomed to today.

Considering the significance and the responsibility of the critical infrastructure for a country and its economy, there are various threats and risks that can well disrupt this system's functioning or damage the system as a whole, thus, they need to be managed and assessed as well. These risks may well threaten the security of the nation and may

include natural disasters like earthquakes and floods to system failure or increased criminal activity that may disrupt the interconnected networks within that infrastructure or its extensive supply chain. Therefore, the increasing bends towards resilience as a concept and a resilient critical infrastructure, which may contribute to the reduction from these threats or at least, strategize to minimize the risks associated with the unpredictable, disastrous or catastrophic events. Risk is correctly defined in Moteff's study as the function of threat, vulnerability and consequences depending on the extent and degree of the event or threat. There are numerous events of threats that, in varying degrees can be disastrous for the national infrastructure of any country and for that reason alone a resilient infrastructure is required, that is, to minimize the potential magnitude of that threat to the security of the infrastructure. The closest example could be the improvement in the existing fly over to better absorb the shocks of an earthquake displacement, thus reducing the potential sizeable loss of people's lives and destruction of the nearby property.

#### 3.3 Resilient Infrastructure—Basic Actions and Strategies

It is established that the critical infrastructure of a country is basically a system, one that interconnected and interdependent on the several subsystems operating within. The importance of a resilient infrastructure has been established earlier in the study as well. Resilience for the infrastructure of the nation is immeasurable; it is commonly measured in terms of the period of time it takes the system to recover from any unusual event, or the other way would be the overall lost performance during the recovery period of the system from any kind of shock or hazard. It is more dependent on the decision making body or the policy makers associated to the critical infrastructure development and operations of a nation.

One of the most important basic factors for establishment of a resilient infrastructure is preparedness, that is, the planning stage in preparation for any potential event or natural disaster for a nation and its authorities for policies and strategies. Most of the studies and literature discuss the need of contingency planning, re modeling of many systematic operations and take it a step further from anticipation and assessment of risks associated with different potential threats and risks. Developing and identifying the backup systems and strategies need to be planned and prepared for in advance at all times, how to install the systems in the presence of any kind of disruption in the normal operations and all the related workings need to be planned for. Thus, planning and preparedness is the most basic component in establishing a resilient critical infrastructure.

Developing a backup or a substitute processes and systems are another way of continuing the running of the critical infrastructure in the periods of a threat or an event that may well disrupt the normal operations and negatively impact the performance of the system and may result in significant losses for the nation as a whole. This is a resilience enhancing strategy considering the replacement is present in case any disastrous event occurs, thus, reducing the associated risks and loss of productivity and performance. Thus, back up or substitute presence is one way of enhancing resilience for the national critical infrastructure. The most probable example would be having the backup electricity plant or transformers to keep the industries running in case of power failures or electricity

catastrophe that is quite probable in a Pakistani scenario where the problem of electric failure and load shedding persists.

*The components involved in Promotion of Resilience:*

Resilience for an infrastructure is determinant of four dimensions that are: (1) Robustness, that is, it should have the strength to absorb the shock to the system and stay put when the normal functionality is disrupted; (2) Redundancy, an alternative system or back up functionality plan in the case of the normal operatives being dysfunctional or no longer being useful; (3) Resourcefulness, that is, it should have the quality of being able to recover or cope up from the negative occurrences; and (4) Rapidity, that is the capability of the system to recover back to its normal functionality or the speed at which it handles and bounces back from a difficult situation. These four determinants are the basic qualities for a resilient critical infrastructure for any nation addressing its organizational dimension, the technical and complex dimension, the economic and the social aspects that in turn establishes a resilient community or a nation.

It's important considering today's global scenario, that resilience be promoted on an extensive scale as its critical for countries at present to establish critical infrastructure with resilience embedded in it to deal effectively and efficiently with the different natures of disasters and threats that risk the security of its national infrastructure in any way. Following aspects and factors shall be kept in account to promote resilience:

- Education and Awareness: it's important that the citizens of the countries be educated about the different forms of disasters that might threaten to risk their national infrastructures security and may result in extensive catastrophic consequences. They need to be made aware of the importance of the critical national infrastructure and risks associated with different disasters. This may need to involve educational institutes, the media, communication mediums and different bodies.
- Preparedness and Planning: As discussed earlier in the study that being resilient requires planning and preparedness, as to how to deal with a complex situation or unpredictable disaster and how to come back to normal after it as quickly as possible. With rapid advancement in technology and extensive historical experiences, many complex models and network systems have been developed that enable the planners to study, analyze and examine the various different responses to any given situation from historical and allow them to strategize and develop policies with improvements to make the nation better able to handle the situation be it arises again in the future. This factor also involves disaster planning, contingency planning and simulation exercises for preparedness and anticipation of any negative event.
- Leadership Involvement and Commitment: it's important, actually the most critical element in building resilient communities and nations. It's important

for the leaders to be involved and committed to the sole purpose of building and developing a resilient critical infrastructure to develop stronger and better equipped nations that are minimally exposed to threat and have a protected infrastructure. For leadership to be effective it's important all the other associated bodies like the engineering aspect and the communications networks to be effectively communicating and advising the leaders, who in turn communicate with the masses and strategize and prepare plans and policies.

- Resource Allocation: organization is the essential component of developing effective resilient strategies and plans. As the resilient critical infrastructure needs financial and extensive periods of time to be built and developed.

Thus, the collaborations of all the different sectors of the system and their effective connectivity is essential for the building of resilient infrastructures and in turn resilient communities

### **3.4 Strategies and Policies for a Resilient Critical Infrastructure of Developed Countries**

The study will discuss some of the strategies and frameworks planned and developed by different countries like Australia and United States of America for their critical infrastructure and its resilience. This will establish the basic guidelines on how the under developed and developing nations can adopt some of the plans and learn from these countries, in order to develop resilient infrastructure for their own countries.

*Australian Critical Infrastructure Resilience Strategy:*

The Australian Government is aware that the vibrant nation and thriving economy is the result for the critical infrastructure and is dependent on the delivery of services via the critical infrastructure. Their strategy towards a resilient critical infrastructure, one that supports the country and is secured against the risks of many natural and unnatural hazards, is to assess and anticipate both the predictable and unpredictable events, which in any way can pose risks to its systems. The Government of Australia understands and stresses the collaborations of the Government with the private sector that holds a significant functioning of the infrastructures, to raise the awareness about the interdependencies of the systems and sub systems and the need to establish on a solid resilient foundation. The Government of the country has developed the Trusted Information Sharing Network (TISN) so as to establish the Government- Private partnerships for Critical Infrastructure Resilience. The resilient critical infrastructure strategy by the Australian Government has six components: (1) building effective Government and business collaborations (2) create and promote a body for resilience and its association with the critical infrastructure of the country, (3) understanding and examining the inter connectivity and dependence of the systems and its sub systems, (4) being time efficient and communicating effectively to make the right decisions at the right time, (5) Australian Governments Cyber Security strategy to be applied to have a secure high technology and electronic operations that are protected and (6) supporting the governments strategies and plans for resilient critical infrastructure in

any way possible.

In the year 2009, the disaster resilient strategy was developed which clearly stated that it was not the responsibility of the Government alone, but the shared connection between the individuals, households, communities and businesses as well. It developed a National Emergency Management Committee (NEMC) for this sole purpose, and was responsible to collaborate with all the different parties together on the same page. The past CIP strategy included only preparedness against the predictable occurrences, but today they have an effective strategy for resilient critical infrastructure strategy for unpredictable risky threats as well that pose security challenges to the infrastructure and its functioning. They have a separate National Critical Infrastructure Resilience Committee to coordinate the activities of resilient strategies and protection plans for an effective broader approach towards a resilient infrastructure strategy.

#### *National Critical Infrastructure Strategy of Canada:*

The National Strategy and Action Plan for Critical Infrastructure of Canada is a risk based strategy that aims at embedding resiliency in the critical infrastructure of the nation because they believe that any disruption in the system may well result in disastrous consequences, life loss and may shatter the confidence the citizens have in the system. The strategists and policy makers realized the importance of collaborations amongst the Government and the private ownerships, which have a stake in the critical infrastructure of the country in any way. The Public Safety Canada and the different stakeholders work together in assessing risks threatening the security of the critical infrastructure of the country and strategize to manage these risks, minimizing the exposure to these threats and increase resilience; and these sectors include: The Government, Financial tier, Health and Food Department, Information and Technology Sector, Water and Energy, Transportation and Safety of the country. The objective of the strategy is to establish meaningful partnerships, implement the risk management approach to deal and recover from the disruptions quickly and to share timely information with the partners. It has established an Emergency Management Framework for Canada for the protection and security of the citizens of the country that recognizes the importance of support amongst all the important sectors of the critical infrastructure and partnerships and understands the link between emergency management and the risk functions including avoiding, minimizing, assessment, dealing and recovering from the effects.

### **3.5 The Case Study of Pakistan**

Pakistani economy is facing four major challenges being: (1) Deceleration in growth, (2) Rising inflation, (3) Growing fiscal deficit and (4) Widening trade and current account deficit. The year 2007-2008 had been trying years but amongst these disruptions the economic indicators of the country presented robustness and reflected the resilience of the economy. These times were a period of political unrest, unstable law and order situation, rising oil and commodity prices on a global level, rising inflation of local food and the global economic crises for Pakistan. The global economic crises have had its significant impact on the country in 2007 and 2008 like the other nations. It had its

adverse impacts on the capital market, money and credit market as well as various other sectors of the economy of Pakistan, though the analysts suggest that the hit the country wasn't as worse as many others had as a result of the economic crises. This was because the country's economic growth was stated at 5.8 percent presenting a picture of optimism and resilience of the country, but again Pakistan is known to be one the unpredictable nations of the world. The service sector of the country performed steadily and showed growth of 8.2 percent, the highest production level of sugar cane at 63.9 million tonnes was achieved, Gross Domestic Product illustrated growth of 15.2 percent and the country's per capita income crossed its \$1000 mark.

On the other hand, agricultural activities performed poorly and were at 1.5 percent missing its target of 4.8 percent, manufacturing decelerated to 5.4 percent instead of its targeted 10.9 percent. The overall investment declined to 21.6 percent from 23.3 percent, the Government borrowing from State Bank of Pakistan reached at its highest at Rs. 544 billion with stocks of borrowing of about 9 percent of Gross Domestic Product at Rs. 946 billion. The fiscal deficit reached approximately 6.5 percent against Gross Domestic Product (GDP) and Government violated the Responsibility and Debt Limitation Act of 2005 due to large fiscal deficit of approximately Rs. 287 billion instead of the targeted zero. The foreign exchange reserves depleted rapidly and the country was restricted from launching sovereign and exchangeable bonds in that period. Thus, illustrating the significant negative impact of the global recession, and that too on the Governmental level, the hit it had on common businesses and employees of the nation is a separate chapter altogether.

Other example can be taken of the 2005 earthquake in Kashmir, in Pakistan. The earthquake of 7.6 magnitudes on 8<sup>th</sup> October of the year 2005 occurred in Kashmir resulting in massive deaths approximately standing at 87,350 people, 3.5 million people were homeless in one day, 250000 farm animals died and many others suffered disastrous effects. At the same time, 780, 000 buildings were approximately ruined including educational institutes and hospitals, important roads and highways were limited due to landslides and system failures. Electricity, water and food supply, information technology and communications were destroyed and remained inactive for a considerable period of time. The cost for the destruction was estimated to be at 3.5 billion dollars by the World Bank. The major challenges faced the nation including the housing of the homeless population, the construction of buildings, reinstallation of communication lines and construction roads and highways etc. The mismanagement and the considerable period of time that the Government took to manage all the consequences was an example of how strategies and management frameworks were required for disaster management at such times, the need for a resilient critical infrastructure and risk based approach to protect the basic foundation was established.

Not only these two events, but the floods of 2010 and 2013 are disastrous events that disrupted the critical infrastructure of the country for prolonged periods of time, posing risk threats and breaching its security and thus, the need grew to have resilient critical infrastructure to better manage the risks associated with predictable and unpredictable threats. The impact they have on the financial and economic tires of the nation leaves it defenseless and under the ruins of the event for long periods of time that decelerates the growth of the economy and negatively impacts the population. Therefore, there is

a need for a framework and strategic policies to address this issue and support the growth of resilient nation that may develop with a resilient infrastructure.

#### 4. ANALYSIS AND DISCUSSION

Pakistan is sorted amongst one of the vulnerable countries across the globe. This is in light of the past disastrous events including the floods of 2010, 2011 and 2012, as well as the earthquake of 2005 and then 2008, the hit of the global recession and many other catastrophic events that have had their significant impact on the country's sustainable development and disrupted its growth and economic progress. National Disaster Risk Management Act 2010 had been an effort towards alignment of the activities for managing risks associated with different events that threatened the security of the national critical infrastructure that had formerly been carried out individually at different levels of the Government. This body has a risk based policy that has a much more complete approach towards disaster reduction activities via anticipating, assessing, mitigating and preventing the risks associated with different probable events. Its objective is to include strategies and frameworks that will add resilience to the current infrastructure and may be in a better shape to deal with events that may pose threats to its security in the future.

The challenges being faced by Pakistan is its lack of knowledge and awareness pertaining to the risks and its associated consequence in respect to its critical infrastructure. It is the result of both unavailability of the data analysis and lack of understanding of the events and their causes. The system to analyze and understand this factor is missing and needs to be addressed considering the advancement and changing dynamics of the global world. Secondly, the lack of involvement and commitment of the higher level of the Government and policy makers pertaining to disaster risk reduction planning and processes is lacking. Though steps have been taken addressing different levels of issues of the nation, the work and planning is still in their beginning stages and needs to be considered and analyzed by the policy makers and decision making bodies of the nation. The lack of system of monitoring and accountability, the missing leadership involvement and lack of resources all contribute to this challenge the nation is facing. Thirdly, decentralization of the risk managing and framework development against hazards of all kind is one of the major issues in the process. The disaster risk management approach is a risk based approach that requires a national initiative rather than being handled differently at different Governmental tiers. Therefore, all these challenges and lacks contribute to the low resistant critical infrastructure of the country at present, though steps have been taken and attempts are being made such as the development of National Disaster Risk Management body, but it is all still in their initial stages and need much more that being provided at present.

Keeping in account, the current case scenario of Pakistan, it is evident that the country is in dire need of a much holistic risk based approach to mitigate the vulnerability of the country against hazardous situation and threatening events that may disrupt the operative critical infrastructure and threaten its security by disrupting the system or resultant system failure, that in turn effects all the other systems and sectors. The policy makers and decision authorities need to consider the lack of resilience in our critical infrastructure and the growing need to embed it in the overall system so as to prepare

better for future catastrophes and risky events, wither probable or not. The need for understanding of the concept of resiliency and its importance pertaining to the national infrastructure is an important challenge for the country that needs to be addressed and looked into considering the advancement of the other developing countries in the similar area.

#### CONCLUSION AND RECOMMENDATIONS

The study illustrates the lack of resilience in Pakistan's critical infrastructure considering the damage it cost the country as a whole in different disasters in different periods of time and the disruption to the system to the brink of system failure causing the country its growth and deceleration of economy at many times, much of which is still being managed and recovered from. The study concludes that the challenges to the development of the resilient critical infrastructure include:

- Lack of resources and the optimum organization and allocation of resources, though plans have been made and strategies have been drafted time and again with no success. Much of which went across is still in its initial stages.
- Lack of institutional capacity and expertise in implementation of plans and policies due to deficiency of awareness and knowledge of risks to the security of the infrastructure and the need of resilience built in it to manage the consequences better.
- Absence of trained and educated personnel and policy makers because of lack of technical education being provided in disaster risk management of the nation and lack of technological tools for its implementation.
- Unavailability of data and data analysis tools to anticipate assess and mitigate the risks associated to the infrastructure as a result of its disruption in the event of any adverse occurrence.
- Lack of commitment and involvement of the higher offices and decision making bodies in addition to absence of a centralized and holistic approach for national disaster management and development of resilient infrastructure for the nation.

The study in light of all the discussion and analysis, recommends that education be provided to develop human resource that is aware and knowledgeable about the risk management approach to building a resilient critical infrastructure and understand the different risks threatening the infrastructure and the systems interconnected for the operation of the nation. The awareness be provided to the citizens in general via educational institutes, the media and the Governmental intervention so they understand the importance of the critical infrastructure to the nation and the need of building resilient communities. Secondly, though efforts are being made in the direction of developing frameworks and strategies to build resilience in the national system, the bodies need to prepare and plan for the future events, keeping under consideration the

previous trends and data so as to analyze and gather information so as to better prepare the infrastructure to deal and recover from them. The role of leadership is imminent in building a critical national infrastructure that is strengthened in resilience. The centralized approach to it and commitment to the objective is critical so as to establish the policies and strategies that are able to manage the risk and develop a resilient nation. Fourthly, the effective and efficient allocation of resources required to develop a resilient framework for development of the resilient infrastructure that again requires the involvement of the leadership that will contribute to driving the effort home. Thus, Pakistan needs to build resilient communities using strategies and frameworks to develop a resilient critical infrastructure that is protected and secures against probable risks, in order to establish a resilient nation.

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