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# Risk Balancing in the Programmes – An Application in the Telecom Domain

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***Abstract***

*Although risk management is an essential requisite for success of all endeavors, it is highly important to balance the risky contexts in the programmes for realizing the organizational gains and strategies. As the programmes remark a distinct locus in the organizational hierarchy, they mandate adoption of precise risk management approaches. Telecommunication development programmes are risky and complex undertakings; consequently they obligate meticulous controls in order to be prosperous. This study seeks the implementation of a specialized programme risk management procedure for a large-scale development programme – the Next Generation Wireless Mobile Services programme – in Pakistan telecom market. The proposed procedure follows the standard risk management process in an organized way, utilizes certain decision tools, and attempts to balance the risks facing the programme. It demonstrates how some information gathering ideas together with the popular tools e.g. the Analytical Hierarchy Process, the As Low as Reasonably Practicable rationale and the Standard Deviation notions can be used for balancing the risky environs in the subject programme. The results present substantive improvement in the risk exposures of said telecom programme and authenticate the methodology offered. This approach can also be useful in managing risks in a variety of other (large-scale) programmes.*

***Keywords:*** *Programme Management; Risk Management; Organized methodology; Decision Making; Next Generation Wireless Mobile Services (NGWMS) programme*

## 1. Introduction

Due to unprecedented developments in engineering and marketing, the times have indeed changed. Organizational strategies are becoming more risky in view of the mounting competitiveness coupled with constant changes in the operating environments. Technological advancements in the fast-paced industries such as the information and communications technology (ICT), telecommunications, defense and research and development have obligated the organizations to adopt increasingly risky initiatives. The rapid and evolving developments have forced the ICT & telecom domains to fall among risky endeavors. The sprouting circumstances obligate the endeavors to assume stringent risk management approaches – the approaches which are responsive, prompt and dependable enough to safeguard the business strategy and the interests of the stakeholders.

Risk is connoted by diverse descriptions in different walks and professions. It is employed to express a conceivable danger, a potential vulnerability, a chance of an accidental

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happening, an uncertainty of return on an investment, and so forth [1]. The International Organization for Standardization (ISO) defines risk as the 'effect of uncertainty on objectives' [2]. Other professional bodies concerning the projects and programmes management express risk as the composite of the probability of happening of a threat (or an opportunity) and the relevant impact on the objectives [3, 4]. While some texts also consider positive notions about risk (termed as positive risk or opportunity [3, 4]), for readers clarity, this script assumes risk in aversive sense merely (*i.e.*, the negative risk or the threat); besides, it adopts the terminologies of risk and uncertainty interchangeably.

Programmes are the establishments comprising of inter-related projects, sub-programmes, or other activities managed in a coordinated way to avail benefits not available from managing them individually [3, 5]. Such formations are meant to take advantage of the synergies, to deliver measurable benefits, and to actualize the goals of the establishments [3, 4]. Whereas the project risks (such as the technical, cost and schedule risks *etc.*,) relate to the successful completion of a project, the programme risks are typically known as the uncertainties connected with transforming high level strategy into new ways of working; in order to deliver benefits to the organization [5, 6]. The programme risks thus differ from the 'typical' project risks; so should be true for the risk management approaches for them both.

During our literature review on approaches and methodologies adopted for risk management, we notice a number of issues. First of all, the majority of designers tend to handle the programmes as projects; they do not differentiate risk approaches between the two. However, some researchers contend this view point, as such a (narrow) view is ill-suited at programme level and may end up with underperformance or even failures in large-scale programmes, at times [7, 8]. Moreover, the mainstream of methods treat the risk course in a 'partial' mode; some restrict their considerations to risk assessment alone (see for instance [9]), while some others just concentrate on how to control it. Although an all-inclusive risk course obligates multiple stages namely identification, assessment, analysis, treatment, and review, the majority schemes scarcely provision methodologies to cover them all. Moreover, the bulk of methods found are either industry specified or project-specific; hence it is harder to validate them elsewhere. Here we may quote the comprehensive review of some risk management methods offered by Stern and Arias [10] where all of them notably belong to the software industry; and they can barely be endorsed in other fields. It would be added opportune for large-scale and complex programmes if a comprehensive methodology embracing the entire risk management course in a well-addressed fashion is available.

ICT (information and communication technology) development programmes are complex endeavors; such developments engage multiple components including projects, products and services. These initiatives embrace multi-dimensional scopes ranging from inhouse software codings to civil infrastructures in the feilds. The case of a wireless telecom deployment programme in Pakistan termed as the Next Generation Wireless Mobile Services (NGWMS) is a known example. The state intended to launch next generation services almost a decade back; however, the programme could not be realized, owing to several risks. The implementation of said programme is yet a big question, and demands comprehensive risk management to realize the programme objectives. Given the distinct requirement of a risk approach at the programme level, and the current requisites of the NGWMS programme, this paper attempts to conceive an organized risk management methodology and proposes its implementation in the said programme.

Remainder of this writing is staged as following. Unit 2 describes the significance and specific focus of risk management in programmes. Unit 3 provides overview of the Pakistan telecom market and the NGWMS programme to the readers. Unit 4 outlines the purposed risk management methodology whereas Unit 5 specifies how this methodological structure is

 

applied in the NGWMS programme and what results are drawn. Some way forward is discussed in Unit 6 while Unit 7 concludes the presented work.

## 2. Programme Risk Management – the Significance and the Specifics

### 2.1. Programme Risk Management and its Significance:

Risk management inside programmes is regarded as a function which identifies, analyses and monitors the threats (or the opportunities) before they befall and obstruct (or accelerate) the realization of programme objectives [11, 12]. The Project Management Body of Knowledge (PMBOK) details the risk management process to have five sub-process which are: Risk Planning, Risk Identification, Qualitative Analysis, Quantitative Analysis, Risk Response Planning, and Monitoring & Controlling the Risk [3]. Besides, some other processes do exist, which are pretty similar in nature; they include the processes outlined by the International Standardization Organization (ISO), Office of the Government of Commerce UK, Project Management Association of Japan, and the Australian/ New Zealand standardization bodies et. [13, 14 ,4 ,15]. The programmes generally witness longer life spans compared to the projects and hold several associated variables; for that reason, certain risks or uncertainties chase them until their dissolution [4, 16, 17]. Remarkably, the programme risks are not solely the aggregate of its component project risks; a programme may also bear such risks which are not reflected by any of its constituent projects [11]. The programme risks are potent enough to constructively or destructively affect the achievements of the programme objectives.

Mainstreams of the professional organizations such as ISO, PMI, OGC, P2M, PRAM, and APM ratify that an effective and efficient management of risks is a key element behind organizational success; it enables the establishments to deliver the envisioned objectives. For instance, ISO emphasizes on integration of risk management function inside the overall organizational governance structure, and recommends uncertainty management to have central focus in organizational processes [13]. Similarly the Japanese guide P2M mandates this role to be able to respond to (external and internal) turbulences; hence dealing with complexity and uncertainty [14]. Consequently, the risk management function has gained significance inside the programmes management performs.

### 2.2. The Specifics of Programme Risk Management:

The programmes house a set of multi-project components and occupy a singular placement (in between the projects and strategy levels) in the organizational ladder [5, 4, 14, 18]. Programme risk management specialists advocate that, inside the programmes, the risks might surface from three distinguishable layers *i.e.*, from the strategy, from (within) the programme, and from the component projects [19, 11]. Figure 1 paints this concept. Due to risk emergence from multiple directions, it becomes necessary to protect and safeguard the programmes from turbulences; such needs can be met through mitigating and balancing the contextual uncertainities.

 

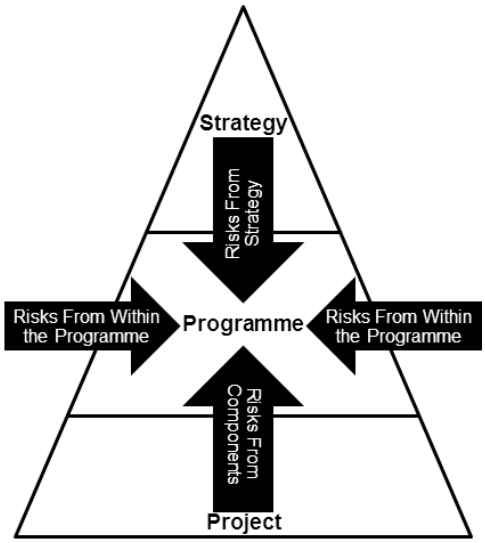


**Figure 1. Risks in the Programmes**

Several researchers maintain that risk management in programmes concentrates on managing the risky environs surrounding the component projects, whereas in case of projects, the entire focus of this function is to manage the assignment specific uncertainties so that the project deliverables are met [8, 20]. For instance, Mark Lyceet debates that instead of focusing on managing the component projects directly, the risk management inside programmes should concentrate on the broad set of contexts surrounding them [21]. In another research, S. Pellegrinelli claims that the foremost job of programme risk managers is to manipulate the contextual uncertainties and safeguard the component projects from external turbulences and pressures [22]. In view of such specifics of the programmes, some researchers discourage taking a project based view for handling the programmes [7].

On grounds of the above rationales, we infer that the programmes should focus on programme-centric risks alone; they should pass on the remainders to contagious levels for a resolve. In doing so, the programmes may delegate and escalate the relevant risks to the project and the strategy levels, respectively. We call this handing over (delegation/ escalation) process as 'Risk Routing'. D. Hillson supports this viewpoint and endorses that while scope of programme risk management should embrace risks from all these sources, the risk reviews at the programme layer must confine attention to the programme pertinent risks, in particular. He adds that from the programme management viewpoint, the project centric and the strategy concerned risks are exogenous; and they should not be the focal point as such [19]. Our readers will be able to understand risk routing phenomenon in detail as we use this notion in our methodology and explain it with example, in a later section.

## 3. The NGWMS Programme – a Contextual View

Before implementing a risk management approach, understanding the context of a program is of paramount significance. Here we attempt to summarize the Pakistan telecom market and the NGWMS program for our readers. Located in the south Asia, Pakistan is a densely populated developing country with five cellular mobile operators (CMOs) having a cumulative subscriber base of 139 million. The recent mobile infrastructure in Pakistan is 2G (voice centric) mainly and the government is in phase of launching 3G/4G (data-centric) mobile services in the state. For this cause, the Ministry of Information Technology (MoIT) –

 

the programme body – is undertaking the Next Generation Wireless Mobile Services (NGWMS) Programme. However, the Pakistan telecom market in general and the subject programme in particular are prone to several challenges [23, 24]. The poor affordability of telecom consumers coupled with relatively larger number of cellular competitors has led the market to fierce competitions; the monthly Average Revenue Per User (ARPU) is badly fallen down, touching as low as $2 (two dollars) mark – one amongst the lowest in the world. Such situation is threatening the cellular business survival. The recent market stats and trends in (2G) telecom industry are portrayed below in Figure 2 [25, 26].

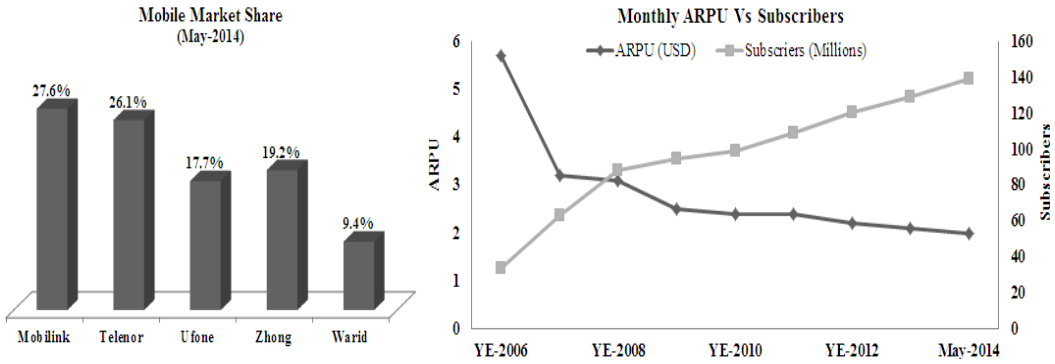


**Figure 2. A Picture of Cellular Mobile Market in Pakistan**

After the market has witnessed phenomenal economic growth on account of 2G services in the republic, the government is resting high hopes on the NGWMS programme. Through this programme, the regime aims to accomplish countrywide e-services and e-environments; a prime objective set by the strategy echelons is to attain 100% broadband internet access in the leading 70 cities of the republic in coming five years [27]. NGWMS is regarded as a large scale programme as it is linked to the strategic drive, involves multi-billion dollar investments, comprises manifold projects and sub-programmes, spans over multiple years, and possesses higher degree of uncertainty and complexity [28].

Given the programme related uncertainties and mounting concerns of the major stakeholders (CMOs in particular), how to materialize MGWMS objectives is a big question. Good governance of the programme blended with adequate risk management dealings is perhaps the right answer. The CMOs contend that the NGWMS may not deliver the intended purposes until the risks associated to this initiative remain unaddressed [29, 30, 31]. We envision that risks facing this endeavour need to be well managed to meet success; consequently embracement of an organized and comprehensive management approach is necessary, truly from its initiation stage.

## 4. Proposed Scheme for Risk Management in the NGWMS Programme

Given the above contexts, a specialized risk management course was proposed and implemented in the NGWMS; the approach and the procedure adopted are obtainable in Figure 3 below.

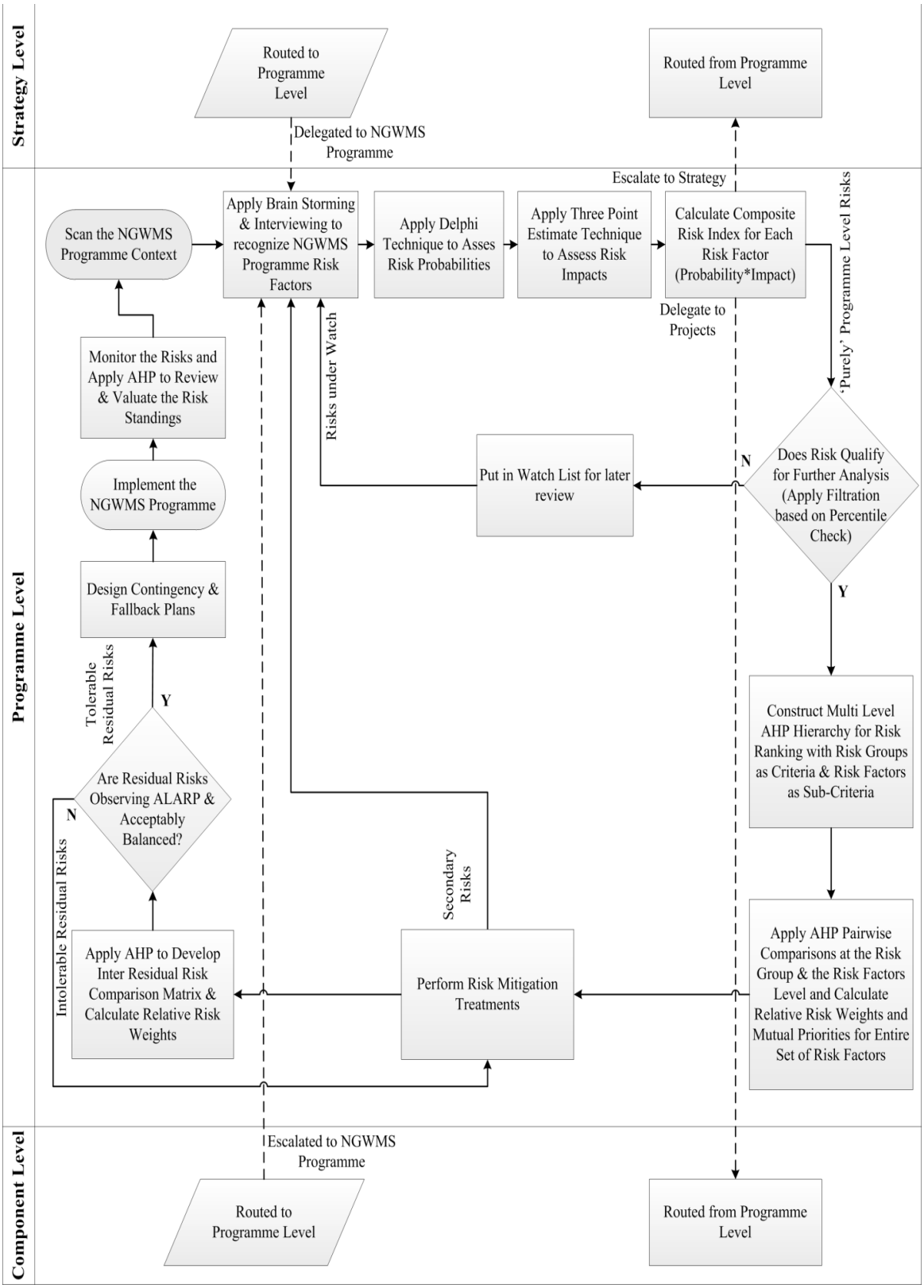


**Figure 3. Organized Procedure for Risk Balancing in the NWGMS Programme**

The drawn procedure utilizes several tools for information gathering; it also employs some decision making techniques. Some of them are captioned hereunder.

- Interviewing and brain storming to scan the programme environment and recognizing the risks.
- Delphi Surveys to assess the probability of happening of risks.
- Three Point Estimates Method to assess the likely impact of each risk.
- Composite Risk Index calculation to determine overall risk value against each risk.
- Percentile valuation to filter the substantial risks for advanced analysis.
- Analytical Hierarchy Process (AHP) to develop mutual risk priorities.
- As Low as Reasonably Practicable (ALARP) principle for risk appraisals.
- Standard Deviation calculations for mutual balancing judgments against risks.

Markedly, the subject model vividly differentiates the management at programme level from the contagious layers (*i.e.*, strategy and project) and inclines to balance the NGWMS risks for improved programme growth. The details of proposed sketch are obtainable as we commence the study in the coming section.

## 5. Putting Ideas into Practice – Risk Management Rehearsed

In order to explore the NGWMS risks, a systematic study (in line with the offered scheme) was conducted. For the investigation purposes, a research group (comprising of two academic researcher and two ICT experts) was assumed. The programme environment was scanned first of all and the (internal & external) contexts were determined. In order to form a multidisciplinary expert panel, 18 telecom professionals (representing the primary stakeholders set) and 10 other experts from the industry and the academia (representing the secondary stakeholders set) were chosen. Later on these experts were reached for information gathering under multiple sittings; they were primarily contacted during professional seminars, training programmes, product and service demos, and sometimes through personal contacts. During this five months long study, on average, 61% of the participant experts responded to our questionnaires and surveys. The qualified responses experienced were however never less than ten (10), which seems a rational sample size for such theme; the similar is endorsed by some researchers for relevant patterns [32, 33].

During the opening exercises, formal and informal interviews and brainstorming sessions were held with the experts, whereby an exhaustive list of risks counting ten (10) risk groups and thirty nine (39) risk factors facing the NGWMS was recognized. At this stage the entire range of risks (including the projects, programme and strategy level risks) which might influence the programme were identified. Interviews and brainstorming are measured as common methods for qualitative data/ evidence collection [34],[35]. During this development the panellist experts were inquired about ‘what could go wrong with the NGWMS programme’ and ‘what are the possible risks attached to the NGWMS (in perspectives of its goals achievement)’. Figure 4 presents the NGWMS risks hierarchy conceived.

 

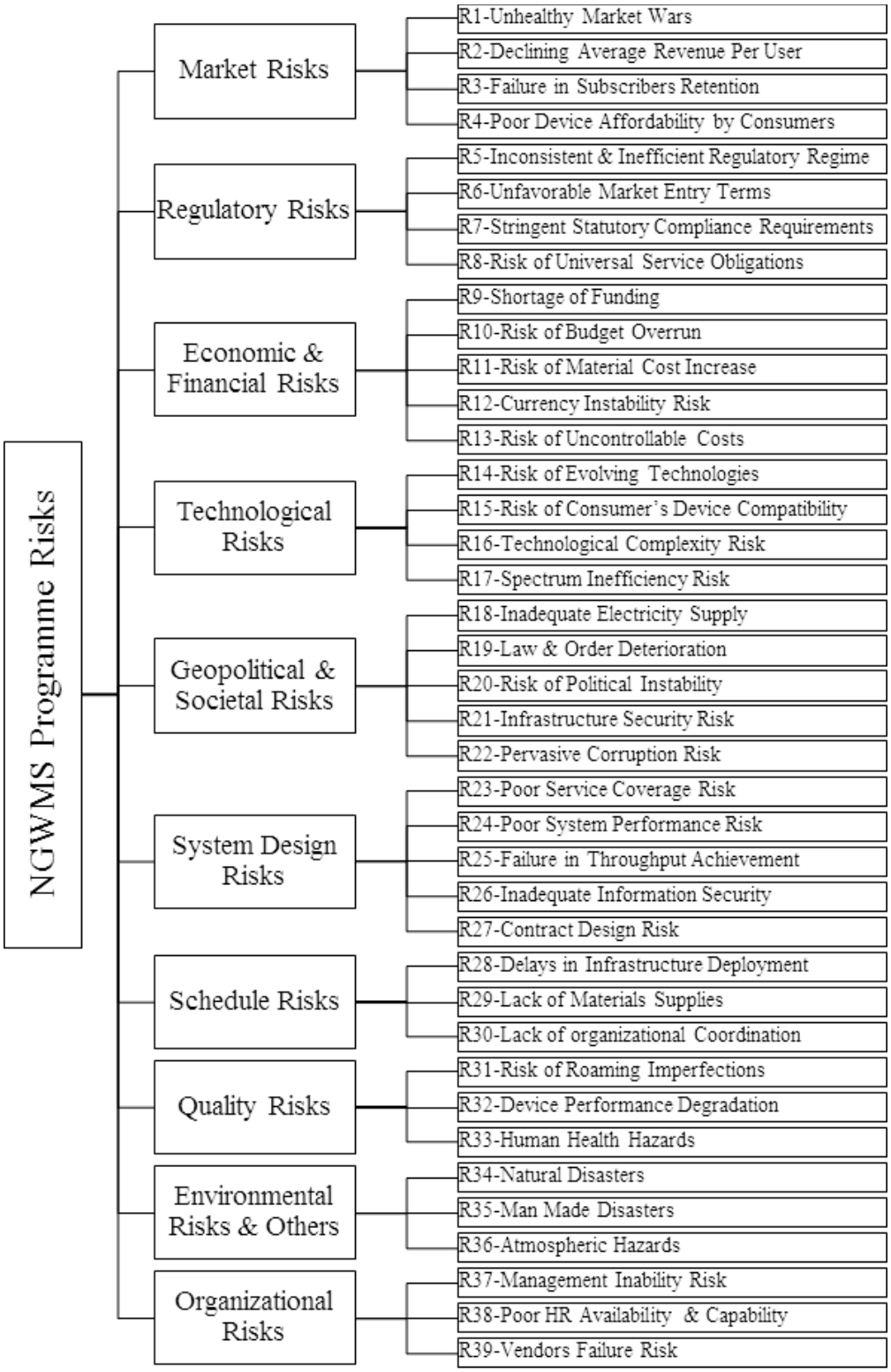


**Figure 4. NGWMS Risks Hierarchy**

Next, a two round Delphi Survey was conducted in order to assess the probability of happening of each risk [36]. Although a three round Delphi was more beneficial for superior unanimity, we compromised on two spells [37] to save on time and effort. During these rounds of Delphi, the opinions of experts were recorded and synthesized through anonymous written surveys. The Delphi methodology was preferred for such information gathering on account of its advantageous characteristics, such as impartiality, consensus-formation, subject anonymity, and controlled feedback [38, 39, 40]. The results obtained can be seen in Table 1.

## Table 1. Delphi and Three Points Estimate Survey Results and Risk Routing Decisions

Qualified responses (Delphi): first round=14, second round=12; Qualified responses (Three Points Estimate):14

| Risks | Delphi Results [Risk Probability Assessment] (Average Scores out of 100) | | Three Points Estimate [Risk Impact Assessment] (Average Scores out of 10) | | | | Risk Value (P*I) | Decisions on Routing Destinations |
|---|---|---|---|---|---|---|---|---|
| | First Round | Second Round | O | M | P | (O+4M+P)/6 | | |
| R1-Unhealthy Market Wars | 78.2 | 78.3 | 4.5 | 6.4 | 7.9 | 6.3 | 495.8 | Component & Programme |
| R2-Declining Average Revenue Per User | 81.7 | 81.7 | 7.2 | 8.1 | 9.5 | 8.2 | 668.8 | Component & Programme |
| R3-Failure in Subscribers Retention | 33.2 | 32.5 | 6.0 | 7.6 | 9.0 | 7.6 | 251.1 | Component |
| R4-Poor Device Affordability by Consumers | 32.9 | 32.1 | 3.6 | 5.5 | 6.7 | 5.4 | 176.4 | Programme |
| R5-Inconsistent & Inefficient Regulatory Regime | 84.7 | 86.3 | 6.7 | 7.8 | 9.1 | 7.8 | 662.1 | Programme |
| R6-Unfavorable Market Entry Terms | 67.1 | 68.8 | 4.0 | 5.7 | 7.0 | 5.6 | 376.9 | Programme |
| R7-Stringent Statutory Compliance Requirements | 25.4 | 25.4 | 2.6 | 4.5 | 5.7 | 4.4 | 110.8 | Strategic |
| R8-Risk of Universal Service Obligations | 33.2 | 32.9 | 4.3 | 5.9 | 7.0 | 5.8 | 192.0 | Programme |
| R9-Shortage of Funding | 41.4 | 41.3 | 6.9 | 7.9 | 9.3 | 8.0 | 329.9 | Component |
| R10-Risk of Budget Overrun | 31.4 | 30.8 | 2.9 | 4.5 | 5.6 | 4.4 | 138.4 | Component |
| R11-Risk of Material Cost Increase | 26.4 | 26.3 | 2.2 | 3.4 | 4.8 | 3.5 | 91.2 | Strategic |
| R12-Currency Instability Risk | 20.7 | 20.8 | 2.4 | 3.5 | 4.6 | 3.5 | 73.1 | Strategic |
| R13-Risk of Uncontrollable Costs | 17.9 | 17.9 | 1.4 | 2.2 | 3.4 | 2.2 | 40.1 | Strategic |
| R14-Risk of Evolving Technologies | 32.5 | 31.3 | 6.8 | 7.8 | 9.2 | 7.9 | 256.1 | Component & Programme |
| R15-Risk of Consumer's Device Compatibility | 30.4 | 30.8 | 2.9 | 4.4 | 5.6 | 4.4 | 132.6 | Component & Programme |
| R16-Technological Complexity Risk | 15.4 | 16.3 | 3.6 | 5.5 | 6.7 | 5.4 | 82.5 | Component |
| R17-Spectrum Inefficiency Risk | 35.0 | 35.0 | 2.3 | 4.1 | 6.1 | 4.1 | 145.2 | Component & Programme |
| R18-Inadequate Electricity Supply | 36.4 | 35.4 | 4.3 | 5.9 | 6.9 | 5.8 | 211.2 | Component & Strategic |
| R19-Law & Order Deterioration | 32.1 | 32.9 | 2.5 | 3.6 | 4.8 | 3.6 | 116.7 | Strategic |
| R20-Risk of Political Instability | 15.7 | 15.4 | 1.8 | 2.6 | 4.0 | 2.7 | 42.8 | Strategic |
| R21-Infrastructure Security Risk | 16.8 | 16.1 | 1.0 | 2.2 | 3.2 | 2.2 | 36.6 | Component & Strategic |
| R22-Pervasive Corruption Risk | 16.8 | 15.4 | 1.8 | 2.6 | 4.0 | 2.7 | 45.7 | Component |
| R23-Poor Service Coverage Risk | 30.4 | 31.3 | 2.9 | 4.3 | 5.5 | 4.2 | 128.8 | Component |
| R24-Poor System Performance Risk | 5.1 | 5.3 | 3.9 | 7.0 | 8.7 | 6.8 | 34.3 | Component |
| R25-Failure in Throughput Achievement | 32.9 | 32.1 | 2.2 | 4.3 | 6.5 | 4.3 | 141.8 | Component |
| R26-Inadequate Information Security | 15.0 | 15.4 | 1.1 | 2.2 | 3.2 | 2.2 | 32.9 | Component |
| R27-Contract Design Risk | 8.3 | 9.0 | 1.7 | 2.9 | 4.3 | 3.0 | 24.5 | Component |
| R28-Delays in Infrastructure Deployment | 32.5 | 31.3 | 1.4 | 2.5 | 3.6 | 2.5 | 82.4 | Component & Programme |
| R29-Lack of Materials Supplies | 7.8 | 7.8 | 2.1 | 4.2 | 6.0 | 4.1 | 32.2 | Component & Programme |
| R30-Lack of organizational Coordination | 7.7 | 8.8 | 0.7 | 1.2 | 1.9 | 1.3 | 9.7 | Component & Programme |
| R31-Risk of Roaming Imperfections | 4.7 | 5.2 | 1.3 | 2.1 | 3.5 | 2.2 | 10.5 | Component |
| R32-Device Performance Degradation | 7.6 | 7.6 | 1.5 | 2.8 | 4.1 | 2.8 | 21.3 | Component |
| R33-Human Health Hazards | 4.4 | 4.6 | 0.2 | 0.7 | 1.3 | 0.7 | 3.3 | Component & Programme |
| R34-Natural Disasters | 3.3 | 3.8 | 6.0 | 7.6 | 8.9 | 7.6 | 24.9 | Component & Strategic |
| R35-Man Made Disasters | 5.0 | 4.8 | 3.5 | 5.3 | 6.5 | 5.2 | 26.0 | Component & Strategic |
| R36-Atmospheric Hazards | 6.5 | 5.9 | 0.3 | 0.7 | 1.4 | 0.8 | 5.0 | Component & Strategic |
| R37-Management Inability Risk | 9.6 | 9.9 | 1.0 | 2.1 | 3.0 | 2.1 | 20.2 | Component |
| R38-Poor HR Availability & Capability | 8.0 | 8.3 | 2.6 | 4.3 | 5.6 | 4.3 | 34.0 | Component & Strategic |
| R39-Vendors Failure Risk | 5.7 | 5.9 | 2.8 | 4.2 | 5.5 | 4.2 | 23.9 | Component |

 

Moving further, a Three Point Estimates survey was conducted to assess the severity or impact of each risk (in case it happens). This practice computes the results from three diversified views collected from the experts; the readings are labelled as Optimistic (O), Most likely (M) and Pessimistic (P) views. In course of such solicitations, the experts were asked 'In your opinion, how much impact a risk might bear on the NGWMS (with respect to its goals achievement), in the best, most likely and worst case scenarios?' The final results compiled by (O+4M+P)/6 are reflected in Table 1.

To conclude the estimation phase a composite tabular (Probability*Impact) representing the 'Risk Value' or the Composite Risk Index (CRI) was established; the relevant stats are obtainable in Table 1. The CRI values reflected the risk gravities for preliminary judgements; however they did not truly reveal the comparative risk priorities, for which a detailed risk analysis was decided. An examination of diverse risks (values) revealed that the entire risks were not supposedly resolvable at the programme level. The ownership of each risk (for resolve) was determined and the routing of certain elements to the pertinent (cross) management layers was recommended. While the evident routing choices (discussed in unit 2) comprised the 'delegation' to projects, the 'escalation' to strategy, and entertaining the rest at the programme layer, the actual does observed certain mixed (multi-level routing) decisions as well. Risk routing decisions are complex functions which depend upon the programme's context including (but not limited to) the risk value, resource dependency, time frame, managerial preferential etc. The diverse decisions assumed against each risk (under the directions of the experts) are summarized in Table 1.

To fully understand the concept of risk routing, we discuss the risk of 'Inadequate Electric Supply' inside the programme, for example. If it witnesses negligible (CRI) value (say only few project sites are threatened by lack of commercial electric supply), the likely decision at programme level is delegation to the components level for direct resolve. On the contrary, if it bears moderate value (say several sites are aaffected), in addition to partial delegation to the components, the programme body may also assume the resolution itself (*e.g.*, arranging solar power backups). However if its value is really high (jeopardizing the larger infrastructure), the right routing could be a multi-level pass on; where in addition to the aforementioned choices, a further option may engage an escalation of risk to the strategic levels for an enduring cure. This is how risk routing may help treating a risk at the apt organizational level.

After the routing treatments were decided, a pertinent subset of the risks to (be entertained at the programme level) was realized; the risks had diverse CRI values, ranging from highly critical to the least ones. In consultation with the programme experts, the research group decided to elect top 60 percentile candidates (with respect to CRI values) for advanced risk analysis; the remainder, being relatively insignificant, were put on the watch list for subsequent reviews. The exercise concluded a total of nine (09) risks (obtainable in the Table 2) which were meant to be analysed in detail, so that mitigation responses of applicable strength could be undertaken. To analyse the 'purely programme level' risks in deep, and to discover their mutual (dis)parities the Analytical Hierarchy Process (AHP) was assumed. AHP is a well-known MCDM (Multi Criteria Decision Making) method suitable for both objective and subjective judgements. Due to its easiness and flexibility [41], usage of AHP has been extensively observed in government, finance, education, defence, engineering, and frequent other disciplines (see for example [42, 43, 44, 45]). Three key steps assumed by AHP are the hierarchy construction and representation, priority analysis and synthesis, and use of logical consistency test [46, 47].

In order to apply the Analytical Hierarchy Process, the corresponding risks were clustered together to form different risk groups, namely the Market, Regulatory, and Technological risks. The constructed (three level) AHP hierarchy contained risk ranking as the goal, whereas

 

the risk groups and the risk factors were assumed as the criteria and the sub-criteria respectively. For conducting the AHP survey, specially tailored questionnaires were served and the verdicts of experts on pairwise comparison of risk groups were collected. The insights of participants were recorded (on Saaty's (1-9) scale [33]) through certain queries like 'How much bigger or smaller will the Risk-X be as compared to the Risk-Y in realizing the NGWMS goals?'. Followed by these surveys, the AHP matrix was formulated and the relative weights were computed to ascertain the mutual standing of each risk group; we named them Inter-Group Risk Weights.

Moving ahead, another AHP survey was conducted which followed the similar pattern; in this survey, the risks falling within each risk group were mutually compared and the Intra-Group Risk Weights were calculated. Lastly, each pair of weights under same hierarchical leg were multiplied together to obtain a conclusive weight; we called them Inter-Factor Risk Weights. It concluded the priority of each risk factor within the holistic set of factors, signifying each risk's gravity in relation to the others. The results are portrayed here in Table 2.

**Table 2. Inter-factor Relative Risk Weights & Priorities (pre-mitigation)**

[Qualified responses: 11]

| Risk Group | Inter-Group Risk Weights | Risk Factors | Intra-Group Risk Weights | Inter-Factor Risk Weights | Mutual Priorities |
|---|---|---|---|---|---|
| Regulatory Risks | 0.49 | R5-Inconsistent & Inefficient Regulatory Regime | 0.45 | **0.22** | 1 |
| | | R6-Unfavorable Market Entry Terms | 0.42 | **0.21** | 2 |
| | | R8-Risk of Universal Service Obligations | 0.13 | **0.06** | 5 |
| Market Risks | 0.42 | R2-Declining Average Revenue Per User | 0.49 | **0.20** | 3 |
| | | R1-Unhealthy Market Wars | 0.42 | **0.18** | 4 |
| | | R4-Poor Device Affordability by Consumers | 0.09 | **0.04** | 8 |
| Technological Risks | 0.09 | R14-Risk of Evolving Technologies | 0.49 | **0.05** | 6 |
| | | R17-Spectrum Inefficiency Risk | 0.40 | **0.04** | 7 |
| | | R15-Risk of Consumer's Device Compatibility | 0.10 | **0.01** | 9 |
| | | | | **Mean of Inter-Factor Risk Weights = 0.11** | |
| | | | | **Standard Deviation of Inter-Factor Risk Weights (Pre Mitigation) = 0.08** | |

It is relevant to highlight that sum of all the (Inter-Factor) risk weights (in Table 2) was 1 but certain entities (known as outliers) were exceedingly deviating away from the mean weight/ value (*i.e.*, 0.11). In other words the standard deviation of risk set (*i.e.*, 0.08) was considerably large, indicating an unjust posture of the programme risks (for example R5 > 20*R15); consequently it pointed the need for risk balancing in order to reach consistent programme contexts. The obvious choice was to recommend mitigation measures in equation to the strength (weight) of each risk factor. The motive was twofold: first, to reduce the risk values (CRI), bringing them inside tolerance of the programme; and the second intent was to diminish the mutual disparities of risks, producing such a normalized environment where no risk is seen too big or too small relative to the others. A number of possible measures were conceived and the advantages and disadvantages of each action were discussed.

For risk mitigation, the offered scheme adopted the ALARP (As Low As Reasonably Practicable) principle [48] which asserts that that the efforts (*e.g.*, cost, value, time) exerted on risk mitigation should not run grossly disproportionate to the returns anticipated therefrom. The mitigation scheme also relied on the assumption that all of the risks will progressively sink in proportional to the extenuation efforts exercised. This (alleviation) strategy assumes a 'multi-tier' approach to treat different risks in different tones. It unlocks by addressing the critical weight factors (in the AHP matrix) with deepest exertions, turns towards middle weightage risks with an average focus, and finally deals the smallest weight elements, steadily. Each spell of mitigation implemented this way results in dipping deviation of the outliers from the mean (risk weights) and attests a move towards (risk) balanced programme environment. Risk mitigation courses usually breed secondary risks which are studied during risk identification drill.

Once the mitigation is implemented in the outlined mode, AHP risk weights are computed again and the resulting standard deviations (of relative risk weights) is compared with the pre-mitigation (standard deviation) value. An improved value designates a potential success in risk balancing. Such a progression is reiterated until any (pre) defined criteria (for example 40% reduction in standard deviation of risk weights) are achieved.

In a bid to gauge how the insight of the (panellist) experts changes after the (potential) risk mitigation measures are executed, a 'special approach' was espoused. A catch-up presentation with the activity performed and the results obtained thus far was chalked out; in addition, a matrix (summarized in Table 3) embodying key risks identified vis-à-vis proposed mitigation measures (learnt from the experts in past meetings) was provisioned. The tips contained therein were based on the best proposals founded on the collective beliefs of the experts gathered in past (formal and informal) sessions.

 

**Table 3. Key Risks and Recommended Mitigation Tactics for the NGWMS Programme**

| Risk Category | Risk Factors | Proposed Risk Measures (Programme Level) |
|---|---|---|
| **Market Risks** | Declining Average Revenue Per User<br>Unhealthy Market Wars<br>Poor Device Affordability by Customers | ➢ ARPUs are administered not to fall below a minimum threshold; such ARPUs should be in line and match with international bench marks.<br>➢ Next generation (3/4G) devices are made affoardable for customers through subsidies and/or import channel facilitation.<br>➢ Unhealthy rivaliry is effectively curbed by the Competition Commission of Pakistan to promulgate fairplay and safeguard the operator's interests.<br>➢ Tariff plans by all telecom operators are examined and approved by the Pakistan Telecom Authority (PTA; the telecom regulator) before their executions. |
| **Regulatory Risks** | Inconsistent & Inefficient Regulatory Regime<br>Unfavourable Market Entry Terms<br>Risk of Universal Service Obligations | ➢ Inconsistent regulatory performs are curbed; historic annoyances are avoided and compensated.<br>➢ Fair regulations for level playing and equal opportunity are guaranteed.<br>➢ In cases where rights of programme constituents/participants are hurt, fair compensation is ensured by the regime/ regulator (PTA).<br>➢ Seizure of cellular services beyond limited occasions (that too, decided in advance) are mandated non obligatory; where unavoidable, the regime is bound for compensation of any business loss incurred.<br>➢ Base price for NGWMS entry be curtailed to one half. At least 4 out of 5 (existing) 2G operators are accommodated against NGWMS liscense award.<br>➢ License based on 'pay as you go' models and 'instalments plans' are accommodated<br>➢ Taxations on telecom facilities are cut to match the taxes levied byother parallel segments.<br>➢ NGWMS Rollout obligations under Universal Service Fund (USF), if any, are chalked out and committed in advance.<br>➢ The regime guarantees the persistence of all policies influencing the subject programme, through law enactment; the same are not altered without due concent of the constituents of programme; no matter political horizons witness any number of fluctuations. |
| **Technological Risks** | Risk of Evolving Technologies<br>Spectrum Inefficiency Risk<br>Risk of Consumer Device Compatibility | ➢ With evolving technologies, adaptable telecom regulations are adopted to safeguard the business interests of programme components.<br>➢ Mobility restrictions on prevailing CDMA operations are enforced.<br>➢ In case service degradations are experienced, additional spectrum is granted/ auctioned by the telecom watchdog (PTA).<br>➢ The conditions and policies on imports of next generation devices are relaxed to assure their massive availability. |
| **Miscellaneous Others** | | The program governance thoroughly engages and ensures follow up with the strategic domains to secure<br>➢ Uninterrupted power supply for the entire cellular industry, especially the service nodes; else collection of 'fuel adjustment charges' from the consumers through billing is allowed or compensated by the government in form of subsidy.<br>➢ Telecom installation's security is proofed against terrorism/ sabotage through overall improvement in nation-wide security; else fair compensations against such losses are granted by the government. |

During an ICT seminar where the most of our panellist experts were participating, the said presentation was delivered; the mitigation measures were accentuated, and their views were invited. The larger board of experts agreed with the proposed measures and expressed their confidence in them. Afterwards, the final AHP survey was pleaded. The experts were demanded to 'bear a belief' (for a while) that the agreed mitigation tactics were already materialized in good trust, and they are registering their risk insights in the post-mitigation age. Such explicit deliberation was meant to estimate their risk insights (and risk exposures fronting the NGWMS programme) in the post-mitigation era. Acuities recorded this time were fairly different; the results synthesized over expert's valuations (given in Table 4),

unveiled substantial (43%) reduction in the standard deviation of risk weights as compared to the past value.

**Table 4. Inter Factor Relative Risk Weights & Priorities (Post-Mitigation)**

[Qualified responses: 10]

| Risk Group | Inter-Group Risk Weights | Risk Factors | Intra-Group Risk Weights | Inter-Factor Risk Weights | Mutual Priorities |
|---|---|---|---|---|---|
| **Regulatory Risks** | 0.40 | R5-Inconsistent & Inefficient Regulatory Regime | 0.36 | **0.145** | 4 |
| | | R6-Unfavorable Market Entry Terms | 0.38 | **0.154** | 3 |
| | | R8-Risk of Universal Service Obligations | 0.26 | **0.103** | 5 |
| **Market Risks** | 0.42 | R2-Declining Average Revenue Per User | 0.41 | **0.174** | 1 |
| | | R1-Unhealthy Market Wars | 0.40 | **0.169** | 2 |
| | | R4-Poor Device Affordability by Consumers | 0.18 | **0.078** | 6 |
| **Technological Risks** | 0.18 | R14-Risk of Evolving Technologies | 0.38 | **0.068** | 7 |
| | | R17-Spectrum Inefficiency Risk | 0.37 | **0.066** | 8 |
| | | R15-Risk of Consumer's Device Compatibility | 0.24 | **0.043** | 9 |
| | | | | **Mean of Inter-Factor Risk Weights = 0.11** | |
| | | | | **Standard Deviation of Inter-Factor Risk Weights (Post Mitigation) = 0.05** | |

The inference – based on subject findings – is that the organized risk management course in the (NGWMS) programme may accomplish risk balancing. It deals with the programme risk exposures in several ways. First, it routes the pertinent risks to appropriate (hierarchical) levels so that they can be suitably resolved; and secondly it shields the programme (components) from turbulences by achieving an overall decrease in the risk (values). Additionally, it transforms uneven risk surroundings to comparatively uniform environments (measurable through standard deviation metric). A graphical representation drawn on comparing the pre-mitigation and the post-mitigation risk weights is displayed in Figure 5. It clearly exhibits a reduced dispersion of the risks from the mean value in the post-mitigation setting.

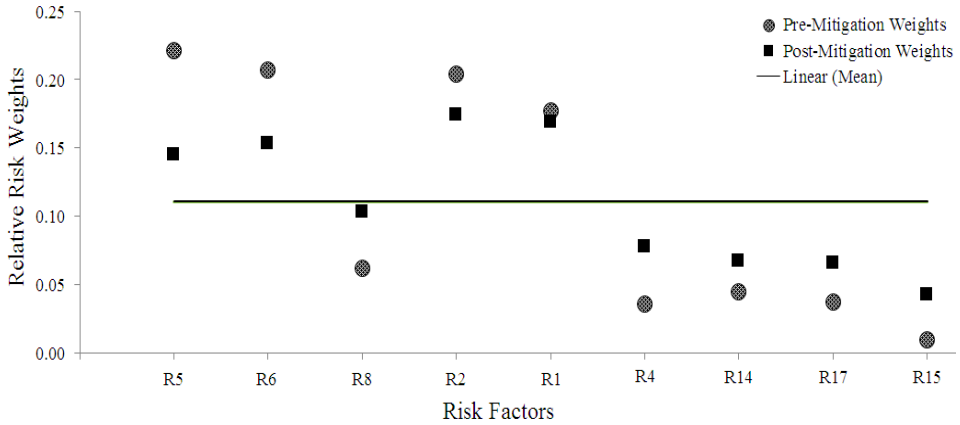


**Figure 5. Relative Risk Weights Comparison (Pre Mitigation Versus Post Mitigation)**

 

By risk balancing we aim to realize a potential positive environment where the NGWMS programme might envisage the entire range of the contiguous risks in symmetric, and residing within its tolerance (limits). In the risk-settled environment, the programme may likely embark with heightened certainty thereby ensuring enhanced success.

Having this done, the offered procedure demands formulating the contingency plans for each residual risk. In addition the fall-back plans are also determined. At this juncture the programme is ready to face any challenges it undergoes; however, a continuous monitoring of risks is mandatory, throughout its course. For risk review and valuations, similar slant may be practiced; it is capable to gauge and contrast the risk standings with the bench marks set forth (in advance) for control reasons. As the programme moves through its lifecycle (formulation-organization-deployment-appraisal-dissolution [49]), new risks encounter; consequently, risk management is spotted as a perpetual process [4]. The given methodology is cyclic in nature; it can accommodate the changing risk needs in varied programmes.

## 6. Way Forward

To expedite the risk balancing course, some enhanced (automated) instruments such as online surveys, spread sheets, computerized AHP application programs (for example Super Decisions, MakeItRational etc.), and similar other tools may also be employed. Since risk is mainly a matter of perception [50], this methodology largely relies on insights of the programme experts. However, in certain cases where some compromise on results is acceptable, a subset of specialists may also assume such doings instead of a large number/ set of experts. To address the risk interdependencies on a thorough basis, employment of ANP (Analytical Network Process) may also be explored; ANP is an extended version of the AHP and popular for accommodating interdependence of criteria and the alternatives under address. A step ahead, the whole scheme may be coded into a computer application to further ease its usage.

We have rehearsed this course to better understand and manage risks in the NGWMS (3/4G) programme in Pakistan; a similar approach can be undertaken to manage advanced generation telecom programmes (such as 4G/5G) in the Chinese or other world markets, as well. In addition, the offered approach can be exercised in many public or private sector endeavours; nonetheless it sounds more appropriate for the large-scale ones. It could be particularly beneficial for management of mega scale public sector engineering programmes.

## 7. Conclusions

Authors of this study tend to highlight that programme risk management is differentiated from the typical project-centric attitude. We maintain that the telecom development programmes are risky and complex drives; so a careful management is mandatory to meet successful realizations. In such context, we undertake a systematic study of the NGWMS programme in Pakistan. We attempt to provision an organized methodology for programme risk management; it is then applied to identify, analyse and manage the risks associated to the said telecom programme. Besides upholding the precise locus of the programmes in multi-level organizational hierarchy, the delineated procedure takes use of two distinct mechanisms - risk routing and risk balancing - to normalize the programme risks. Moreover, it exploits some friendly tools (*e.g.*, Delphi, AHP) and concepts (*e.g.*, ALARP) for decision management in the programme. The discussed approach deals with the programme risks in three distinct modes: 1) avoiding the programmes from exogenous risks; 2) alleviating the programme risks in absolute positions; 3) counterbalancing the programme risks in relative terms. These measures help bringing the programme risks well within the tolerance bounds of

 

the constituents; ultimately a perspective is reached wherein the component projects foresee all the contagious risks indifferently, and in routine. Unlike some hard to implement tactics, this methodology is deliberately instituted using broadly accepted techniques and comfortable procedures; so that the vast majority of practitioners may comprehend and adopt it without trouble. The progressions adopted may be highly beneficial in supervising the risk essentials pertinent to the Next Generation Wireless Mobile Services (NGWMS) programme. This research may facilitate the Pakistan market in realizing the programme goals and strategic objectives in scientific and enhanced way. The tangible findings established in this study can serve as lime light for the regime; it might empower the relevant bodies to be effectual in handling the programme and celebrate the next generation telecom success in the state. Moreover this methodology can also be applied to other similar programmes. With little alteration, this approach can be implemented in certain large-scale projects, as well. The essential argument backing this work is that the (NGWMS) programme may not prosper, unless an efficient risk management (approach) is undertaken as an obligatory headway.

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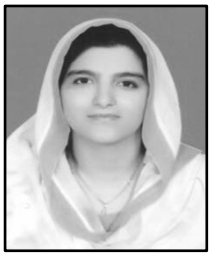

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